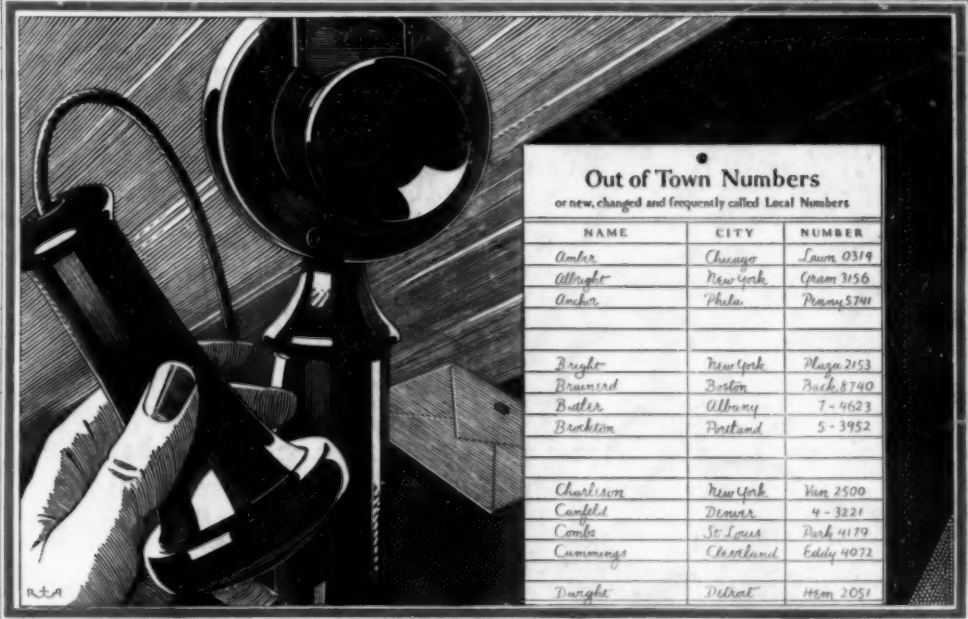


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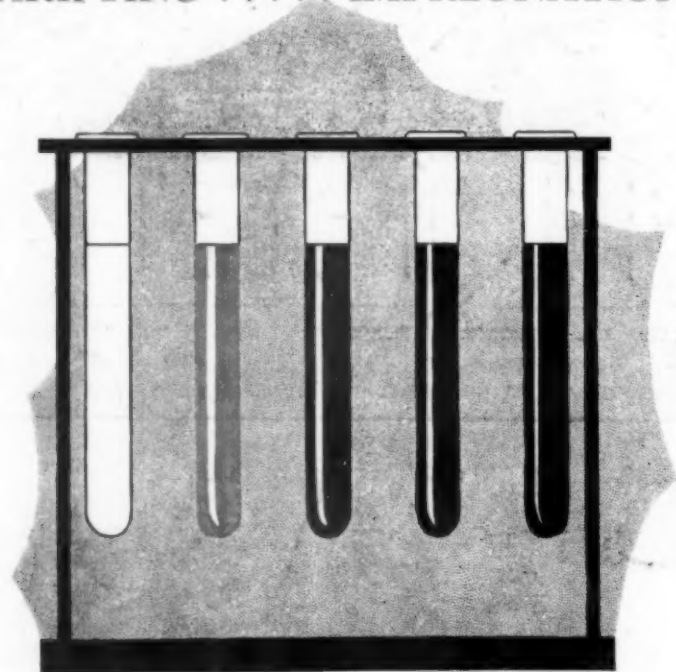
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# CHEMICAL & METALLURGICAL ENGINEERING



A Section of the Plant of the Atmospheric Nitrogen Corporation, Hopewell, Va.

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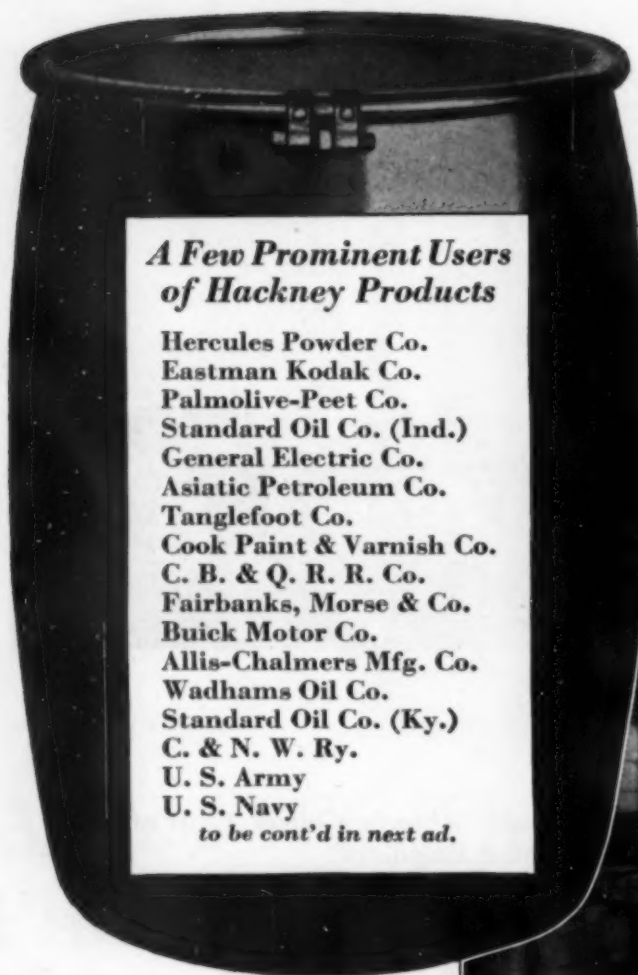
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JULY, 1929

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S. D. KIRKPATRICK, *Editor*

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## *Chemical Engineering Becomes of Age*

**T**WENTY-ONE years ago a small group of chemists and engineers led by Richard K. Meade, Charles F. McKenna, William H. Walker, Arthur D. Little, J. C. Olsen, and William M. Booth, met in Philadelphia to form an organization that would advance the then new cause of chemical engineering and would help to raise its professional status and standards. Last month, within a day of the exact date of the anniversary, the same organization met in the same city and demonstrated the progress it has made toward the original goal of its founders.

**T**ECHNOLOGY and economics found a balance on its program that indicated the very practical character of the chemical engineer's work. That both should be reflected in a number of striking technical and commercial developments is evidence that the combination is fundamentally sound. Synthetic solvents from petroleum and new resins that hold the promise of better lacquers and plastics mark the beginning of industries. Successful commercial manufacture of a useful chemical such as aluminum chloride after fifteen years of patient trial and experiment and the large-scale production of a new commodity, such as diphenyl, to fill an important need in process development are examples of practical technique of applying chemical engineering.

**B**UT the best proof of the maturity of the American Institute of Chemical Engineers lies in the fundamental value that it has placed on the processes of education. In previous conferences held under the auspices

of its committee on chemical engineering education, representatives of industry and of the colleges and universities have agreed on important bases of definition and application. But in the Philadelphia conference, Prof. W. K. Lewis struck the keynote of a greater purpose in training men not for industry but for civilization. It is the engineer rather than the lawyer or the doctor who by training, experience, and habit of thought is equipped to solve the complicated problems of today. He alone understands the machine, can improve its shortcomings, and can appraise its potentialities for good or bad. It is to the colleges and universities, therefore, that we must look for the development of chemical engineers of character and ability who are willing to accept this greater obligation to the community as well as to the profession.

**N**OW that chemical engineering has become of age it is important that its growth and development continue on an ever-broadening scale. Already the Institute has shown a willingness to throw off the old in policy and procedure and to reach out for new achievements. There is much to be done in broadening its membership and extending its influence into fields in which chemical engineering is only beginning to penetrate. This can be accomplished without lowering its standards or making it competitive with other organizations. The birthday meeting at Philadelphia marked a milestone and perhaps a turning point in the Institute's progress toward the high ideals which the founders held for it and the profession it represents.

---

## Endowment for Research

**A**NNOUNCEMENT by the Engineering Foundation that a large proportion of its proposed endowment fund has been raised and that the Foundation has been promised a number of future gifts through legacies, annuities and trusts, is encouraging. The two additional gifts that have been made to aid a research project in iron and steel alloys are particularly opportune. The chemical engineering profession is becoming alloy-conscious, is awakening to the realization that, in most cases, the newer alloys are an enormous improvement over other materials for equipment fabrication. The contribution to the Engineering Societies' Library in New York will be welcomed and gratefully appreciated by the profession. Fortunately, the indications are plentiful that the nation recognizes the necessity for industrial and fundamental research and has reliance in its results.

## What Does the Nitrogen Cartel Mean for American Industries?

**M**ARKET reports summarize the proceedings at the recent meeting of German, British and Chilean interests from which a nitrogen price and trade agreement is to come. American producers and users of nitrogen are naturally interested in this matter and have been asking themselves: "What does this mean for us?"

It is too soon to forecast fully the significance of this international entente. However, it is apparent that the American synthetic nitrogen industry must stand alone in competition with the combined nitrogen industries of the world. It is not too soon, therefore, to give thought to the necessity for developing the American industry to a position of competitive strength or of entire independence of foreign sources of nitrogen. To do this promptly and effectively will make it necessary for us to redesign our present extremely liberal tariff laws with respect to fertilizer nitrogen.

Unaided by government subsidies and at times discouraged by the various uneconomic proposals for the production of fixed nitrogen at the Muscle Shoals plants, the American chemical industry has invested nearly \$50,000,000 in the synthesis of ammonia and its derivatives—all within the past eight years. Moreover, present plans call for an additional expenditure of \$100,000,000 within the next few years.

The formation of the international nitrogen cartel plainly indicates that the American synthetic ammonia industry must shortly face competition of the type that not only violates our anti-trust laws but also is contrary to the American methods of doing business. Whatever the motives that prompted the formation of the nitrogen cartel, they are not for the good of either the American producer or consumer of nitrogen. No hope of permanently lower nitrogen prices is to be expected of the cartel, for the only way in which such an international understanding can benefit its participants is by raising or at least stabilizing the price of nitrogen products.

The policies of the cartel will be dictated by the representatives of the German, Chilean and British interests, which together already control at least three-quarters of the world nitrogen output, and at least one-half of the United States' requirements. Notwithstanding denials

regarding price fixing in the United States, it must be apparent that international control of production and allocation of the world's markets are bound to affect conditions in this country, unless we can set up a trade barrier against the foreign combine.

While the American nitrogen industry does not need prohibitive duties, the lack of tariff protection at this time would expose the young industry to the unfair practices of foreign producers who collectively have hopes of greater participation in the rapidly expanding American market. Viewed in this light our present tariff policy in respect to nitrogen products is extremely shortsighted. An industry that has steadily lowered prices, even during a period of costly development, is deserving of encouragement, particularly when the best interests of agriculture and the national defense are so directly involved.

## Who Will Profit from Cheap Aluminum Chloride?

**F**IFTY YEARS AGO Friedel and Crafts started performing miracles with aluminum chloride and ever since that time the reaction known by the name of this great French chemist and his American associate has been a useful laboratory tool of organic synthesis. Always, however, there has been one serious drawback to its large-scale application: Anhydrous aluminum chloride is difficult to produce and its cost is prohibitive for many purposes. Announcement, therefore, of successful manufacture by a process that puts it into the class of the cheapest heavy chemicals may well open the way to many interesting possibilities.

Dr. A. M. McAfee's modest recital of the fifteen years spent in perfecting the commercial production of aluminum chloride is a classic story of patient, persistent chemical engineering development. His audience at the Philadelphia meeting of the American Institute of Chemical Engineers was quick to acclaim it as an outstanding achievement, although, obviously, it is still too soon to gage its full significance. In the oil industry, to be sure, the McAfee processes for producing gasoline from high-boiling petroleum oils and for refining lubricating oils at moderate temperatures have long demonstrated their worth in the Gulf refinery. The scale of operations there may be judged from court records showing that the company has spent approximately \$4,600,000 on the aluminum chloride division of its Port Arthur refinery. Two carloads of Arkansas bauxite and two carloads of Louisiana salt are said to be consumed each day in the aluminum chloride plant.

In the dye industry the potentialities of cheap aluminum chloride are more difficult to appraise. It is already used on a large scale in the preparation of anthraquinone and its derivatives, which in turn form the basis of most of our faster vat dyestuffs. According to the Tariff Commission's figures the apparent consumption of this class of dyes has increased from 2,815,304 lb. in 1923 to 4,671,645 lb. in 1925 and to 6,648,867 lb. in 1927. With a trend so evident the advent of a new material that will cheapen the cost of anthraquinone is likely to have far-reaching effect on many industries. The producers of intermediates for the older type of dyestuffs must now find other outlets for their products. Manufacturers who have used aluminum rather than bauxite as a starting material for aluminum chloride probably will examine their cost



sheets rather closely. Furthermore, the competitive situation between anthraquinone produced from phthalic anhydride and that produced from aluminum chloride doubtless will be affected and perhaps another material released for other uses.

Dr. McAfee's is the kind of a development that should have a stimulating influence in many fields. We may confidently expect many of the Friedel-Crafts syntheses to come into large-scale production after a half century of enforced retirement. Chemical engineering in the oil industry has paved the way for organic chemical progress.

---

### "Now, Will You Be Good?"

THESE WORDS were used by Charles H. McDowell in reporting for his committee to the National Fertilizer Association meeting on the acceptance by the Federal Trade Commission of the rules of trade practice which have received approval by this governmental agency. In using this language Mr. McDowell very profitably emphasizes the importance to his industry of the co-operation which is given by the Trade Commission in this work.

It is interesting to note that the lime business is seeking similar aid through the National Lime Association. This is a good omen for that industry, which also has been permeated by cut-throat competition and unfair and unsound selling practices. Both lime and fertilizer manufacturers will benefit by this type of effort, just as other industries have benefited. They are going to be protected in aggressive selling methods and in genuine competition against those secret rebates, special discounts, and private adjustments which have been ruinous to all.

It is fortunate that these industries are taking such steps. The problems of manufacture and of distribution which confront them are yet largely unsolved. Now the worthwhile and progressive elements in the industries can give their full energy to the solution of important technologic and business problems.

---

### Government Employees' Patents Again a Serious Problem

AWARD of \$198,500 to Rear Admiral Bradley A. Fiske, a retired officer of the United States Navy, for the use by the government of patents obtained by him on inventions relating to the torpedo-plane was recently made by the Court of the District of Columbia. It has ruled that a military officer has a right to patent an invention in his own name and profit by it even though the government must thereafter pay him such large royalties as those in this case.

There has been great doubt as to how the courts would rule upon such cases which clearly affect the right of the government to use in its own business the results of investigations and inventions of its own officers and employees. Seemingly, the courts are to take the stand that the government has less right to utilize the inventions of individuals paid a regular compensation by it than would any corporation with respect to patents of its employees. This seems to us very strange. It may be a correct interpretation of the law, a fact which we have no right to question. But it certainly is a gross miscarriage of justice, in our opinion.

There may have been extenuating circumstances in this individual case. But the fundamental and general question as to the status of the government and the industries with respect to patents obtained by government men is still seriously involved.

Why should the taxpayers compensate employees or officers of the government for their services if subsequently they must also pay for patents resulting from their employment? How much more serious will it be to have these inventions controlled by private individuals in the case of patents which private industry may wish to use! *Chem. & Met.* has on numerous occasions stated editorially that it sees no justice or reason in the granting of patent rights for private exploitation to individuals in the hire of the government.

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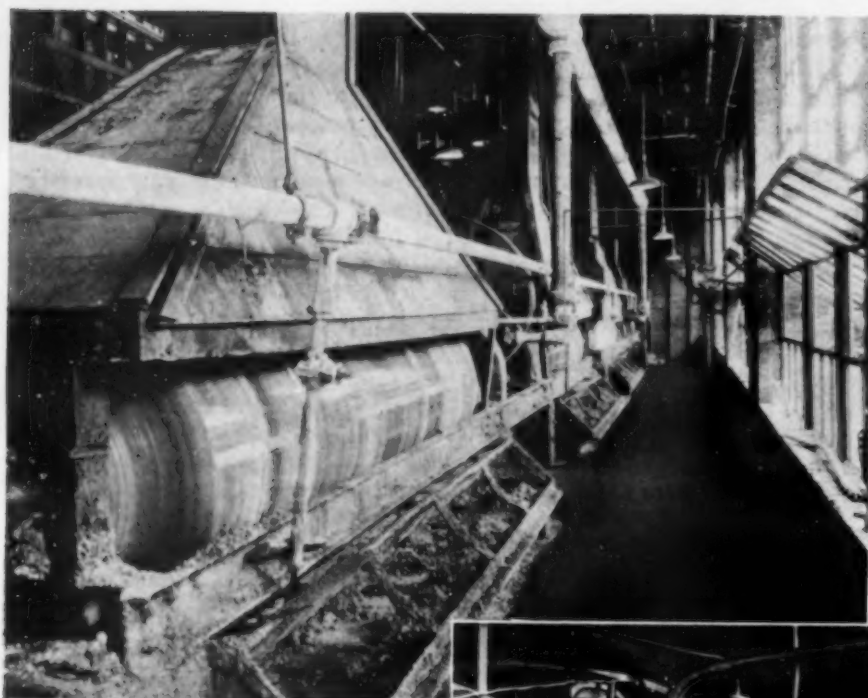
### Responsibility to the Ultimate User

WE LIVE in a complicated chemical civilization. More and more are the products of chemical industry becoming part of our every-day existence—sometimes, without adequate knowledge on the part of the ultimate user. While not directly involved in such unfortunate occurrences as the recent deaths in Chicago due to methyl chloride poisoning, chemical industry nevertheless feels a sense of moral responsibility and obligation in helping to prevent their recurrence.

The relative toxicity of methyl chloride and the various other chemical refrigerants that have come into common use with the recent growth in mechanical refrigeration is well known to chemical manufacturers and to refrigerating engineers and technologists in the industry. Adequate safety provisions are uniformly observed in the plants where these products are manufactured. When they pass into commerce they are shipped in accordance with the strict safety regulations of the Interstate Commerce Commission. The maker of the mechanical refrigerator is duly warned by the chemical manufacturer of the character and properties of the refrigerant, and through the offices of the Underwriters' Laboratories, the American Society of Mechanical Engineers, the American Society of Refrigerating Engineers and similar agencies, he obtains full information in regard to the design and testing of refrigerating equipment, proper materials of construction, and the various precautions and devices for safety. It would seem, therefore, that he must take responsibility for passing this information along to the jobbers and dealers who handle and install the refrigerators, and finally to the owner and ultimate user. Various supervisory and inspection agencies representing federal, state and local health authorities contribute something to the user's protection, but it is apparent to everyone that the whole scheme can be greatly improved.

Mechanical refrigeration has too much at stake to fail in seeing that adequate protection is provided for the users of all of its products. The responsibility of the chemical manufacturer as well as that of every other link in the long chain can be strengthened through co-ordinated effort and understanding. Technical information on toxicity and fire and explosion hazards as well as engineering data on design and construction are already available. The problem is to put this information in understandable form into the hands of the user for his own protection as well as for the ultimate benefit of the several industries involved.



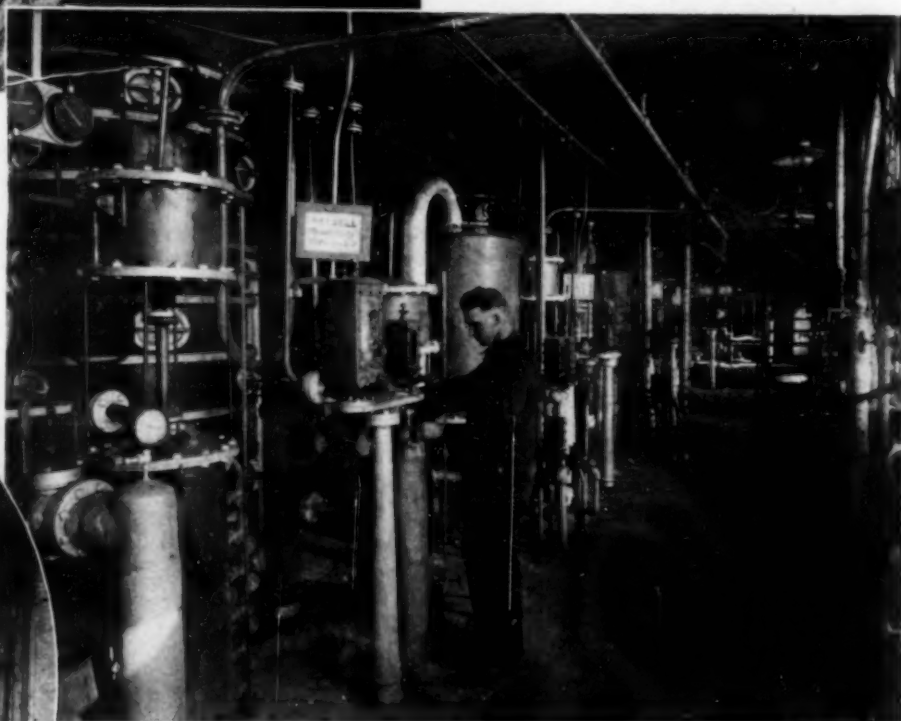


AT KINGSFORT, TENN., the Eastman Kodak Company operates the Tennessee Eastman Corporation as a co-ordinated part of a large lumber business with timber holdings covering thousands of acres in Tennessee, North Carolina, Virginia and Kentucky. The plant is successful because it uses waste as raw material, distilling it to produce essential ingredients for manufacturing film base.

LEFT—Calcium acetate liquor is passed over steam drums to dry it into a "mud" and is then carried by a mesh belt through a heated chamber where it is further dried to the finished form for the market.

### Operations in a Modern Wood Chemical Plant in Tennessee

BELOW—Inside of a retort.



ABOVE—Control room in the methanol refinery.

BELOW—At left is the transfer equipment for removing the steel "buggies" from the retorts. At right are loaded buggies ready to enter preheaters.



# Wood Distillation Still Prospers in Southern States

By *Norman W. Krase*

*Chemical Engineering Division,  
University of Illinois, Urbana, Illinois*

SINCE the advent of synthetic methanol, manufactured in Germany from water gas and in this country from various byproduct gases, many predictions regarding the future of the hardwood distillation industry have been published. Most of these profess to foresee the rapid decline and ultimate disappearance of wood distillation plants as important factors in the chemical industry. While this fate undoubtedly awaits particular units situated unfavorably as regards labor, raw materials and markets, nevertheless it is easy to refute the dire predictions as applied to the industry as a whole. Several plants throughout the Southern States offer excellent examples of the results that can be achieved by co-ordination of interdependent operations, proper location of the plants with regard to sources of raw materials and labor, and effective utilization of by-products.

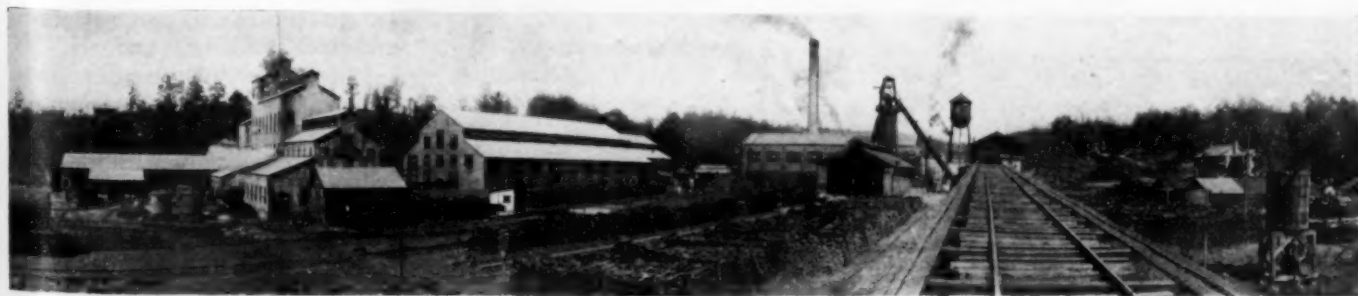
On the opposite page the reader will find a pictorial presentation of certain of the operations of the Tennessee Eastman Corporation, which has a modern wood distillation plant at Kingsport, Tenn. Historically, this plant goes back to the time when the Eastman Kodak Company's supply of essential film ingredients—principally methanol, acetic acid and acetone—was threatened because of war conditions. The operation has been continued not only as a safeguard against future contingencies but also because its location has made it an economic self-supporting industry.

The primary purpose of the present article, however, is to describe in somewhat greater detail the operations of the Tennessee Products Corporation of Nashville, which since March, 1920, has been operating one of the largest wood distillation plants in the country at Lyle, Tenn. Located at the same place is a charcoal iron blast furnace which consumes the bulk of the charcoal produced. The raw supplies for these operations are wood, lime, iron ore, and coal. Hardwoods cut in 4-ft. lengths are harvested from some of the 150,000 acres

owned by the corporation in the vicinity of the plant. Limestone is quarried within an eighth of a mile of the plant. Iron ore is strip-mined less than 5 miles from the point of consumption. The coal mines of the company are at Bon Air Mountain, about midway between Knoxville and Nashville. This fortunate location of raw materials results in important savings in freight charges, which constitute a very large factor in final costs of wood distillation products. It would be difficult to find a finer example in illustrating the economic importance of proper plant location.

ACTUAL operations in this plant begin with the cutting of hardwoods such as oak, hickory, and birch and their storage at suitable points for several months of seasoning. The wood is then brought to the plant, loaded into steel retort cars or "buggies," each holding two and one half cords. These are rolled directly into the carbonizing retorts. Each retort accommodates four cars at a time. For several years the plant operated twenty retorts but two more have just been completed and placed in operation. These retorts are continuously heated and remain practically airtight except when cars are put in or taken out. Coal and non-condensable gas from the distillation products are used as fuel and each retort has its own furnace, independently operated. After four cars with their ten cords of seasoned wood have been charged and the retort closed, distillation begins.

The first product is largely moisture and as the temperature rises other volatile constituents appear. The vapors from the distilling wood pass out of the retort through water-cooled copper tubular condensers which recover all the vapor products as liquids, with the exception of the non-condensable gas, consisting largely of carbon monoxide and carbon dioxide. After a certain period of heating—the interval varying with the character and age of the wood charged—the carbonization becomes exothermic and proceeds autogeneously. At this



Wrigley Wood Distillation Plant and Charcoal Iron Furnace of the Tennessee Products Corporation at Lyle, Tenn.



point the external heating is reduced until the temperature in the retort begins to fall, when the charge is "finished off" by external heating. The usual carbonizing period is 24 hours; this, however, will vary somewhat according to the age of the wood. The steel doors at the end of the retort are then swung open and the four cars, each containing about 125 bushels of charcoal, are rolled out of the retort and into a sealed cooler. Four cars of raw wood are charged immediately and the distillation cycle begins again. The hot charcoal is cooled slowly out of contact with air for 24 hours, passes into a second hermetically sealed cooler for another 24-hour cooling period and is then finally cooled under open sheds for 72 hours more.

As stated previously, 80 to 90 per cent of the charcoal is fed to a blast furnace located adjacent to the cooling sheds. This furnace produces pig iron known as Wrigley semi-cold blast charcoal iron which, because of its strength, smoothness, and close grain, is extensively used in the manufacture of chilled rolls, automotive parts, Diesel engines and car wheels. The iron ore used is a brown hematite running about 50 per cent Fe and low in sulphur and phosphorus. This ore is strip-mined and washed before shipment to the plant. The capacity of the blast furnace is about 80 tons per day.

Returning to the carbonization retorts, we find that the products of distillation, other than charcoal, are separated by cooling into a non-condensable gas, used as fuel, and a liquid known as pyroligneous acid or raw liquor. This liquid is largely water but also contains all the organic products such as methanol, acetic acid, acetone, oils, tars, and many substances of complex and, in many cases, unknown structure. The first treatment is to separate the insoluble tar and pitch by allowing the liquid to flow slowly through large settling tanks. This separated, semi-solid material after processing has found considerable use as a pitch in the rubber industry. The settled, pyroligneous liquor overflows and is fed to evaporators.

**I**N THIS plant four Badger, long-tube, double-effect evaporators are used. The evaporation causes the separation of the so-called soluble tars, which are continuously removed and used for fuel. The liquor is then held in storage tanks until ready for further treatment. All the methanol and acetic acid, etc., is still present in aqueous solution. Batches of this acid liquor are fed to

neutralizing tanks, stirred with milk of lime, and then run to settling tanks. The clear liquid overflow contains methanol, calcium acetate, etc., and is pumped to a continuous steam-heated fractionating still known as a "Lime Lee." The separated sludge is filter pressed, the filtrate is returned to the neutral liquor tanks and the filter cake thrown out.

The Lime Lee still is fed with an aqueous solution of calcium acetate containing 3 to 5 per cent of methanol. The distillate obtained is 90 per cent crude methanol, which goes to storage and shipment. The aqueous "bottoms" from this still are concentrated in double-effect, steam-heated, Badger evaporators, reduced to a "mud" on atmospheric roll driers and fed to a Huillard drier by a chain drag. The acetate of lime is then bagged for shipment.

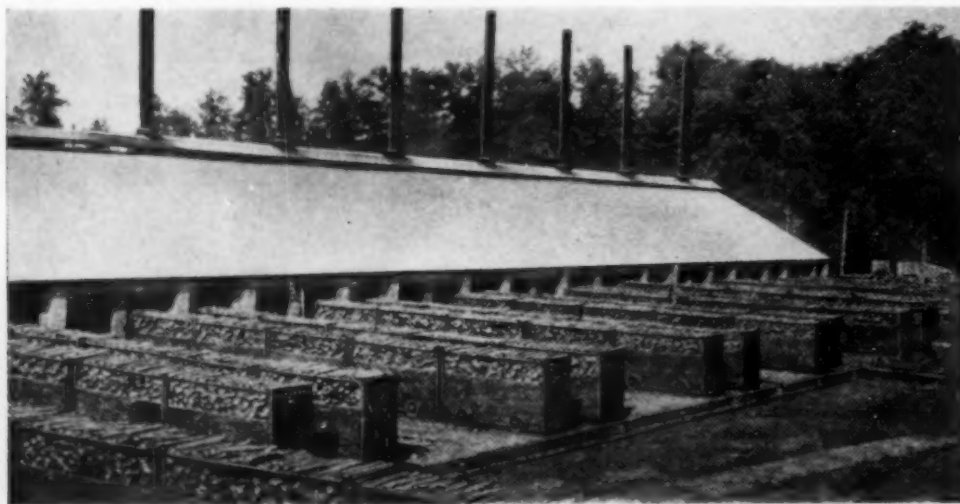
Under present conditions practically all of the crude methanol produced at this plant finds its way to the market as a denaturant. The acetate of lime is sold to white-lead and lacquer-solvent manufacturers.

**T**HE operations at this plant are in general common to all wood-distillation plants. Of particular interest to chemical engineers, however, is the effective utilization of products and byproducts. The all-important problem of charcoal disposal is solved by marketing an equivalent quantity of readily salable high-grade charcoal pig iron. The excess charcoal is sold for domestic use throughout the South. Other examples of the interdependence of the various operations include the use of the blast-furnace gases to generate steam for general process use and the use of the condensed water from the evaporators as boiler feed. This helps greatly to prevent scale formation.

Production data from this plant are of general interest. From one cord of seasoned wood (about 3,600 lb.) about 1,000 lb. of charcoal is produced. Of the weight of wood charged, 15 per cent is non-condensable gas. Between 2,000 and 2,500 gal. of crude 90 per cent methanol is produced per 24 hours. Forty-four thousand pounds of acetate of lime is bagged each 24 hours. Two hundred and twenty cords of wood is carbonized per day in 22 retorts. The daily output of charcoal is 100 to 110 tons.

In addition to operating the plants just described, the Tennessee Products Corporation also owns and operates the Chattanooga Gas & Coke Company, the Rockdale Ferro Phosphorus Blast Furnace, several coal and iron mines and has extensive timber operations. Research and control laboratories are maintained at each plant and work on further improvements and developments is steadily progressing.

The writer acknowledges with pleasure the help received from J. C. Carlin, chief chemist, and N. E. Van Ness, plant superintendent, in the preparation of this article as well as other courtesies shown by the officers of the Tennessee Products Corporation. He is indebted to the Kingsport Development Company for the photographs of the Tennessee Eastman Corporation.



Charcoal Retorts of the Plant at Lyle, Tenn., of the Tennessee Products Corporation. This is One of the Largest Hardwood Distillation Operations in the South



# Chemical Engineering Achievements Reported in Many Fields

## *Editorial Staff Report*

**S**TARTLING new technical and commercial developments, frank discussion and a background of sound chemical engineering technology combined in Philadelphia, June 19 to 21, to give the best technical program in the recent history of the American Institute of Chemical Engineers. The first description of the Govers distillation process, which uses diphenyl as an indirect heating medium, the announcement of a new series of vinyl resins with surprising properties in lacquers, varnishes and plastics, and the successful production on an economical commercial scale of anhydrous aluminum chloride were some of the high lights among the developments reported. On the side of technology, there were informative papers and discussion of theory and practice in a symposium on distillation. Economic rather than technical considerations featured a symposium on lacquers and solvents.

Synthetic solvents from petroleum gases will some day form the basis for a huge American industry. Wallace J. Murray and Earl P. Stevenson, of Arthur D. Little, Inc., placed a dollar measure of \$100,000,000 a year as the field open to this new industry. This figure assumes the replacement or substitution from petroleum sources of acetone, normal butanol, ethyl alcohol, acetic acid, methyl alcohol, fusel oils, ethyl acetate, glycerine and the various derivatives. It does not take into account non-competitive and new uses that would develop for the products derived from petroleum hydrocarbons.

The most obvious and immediate of the products to be developed from petroleum, according to these authors, are the alcohols, glycols and their derivatives. Those already being produced commercially include isopropanol, secondary and tertiary butanol; primary, secondary and tertiary pentanol, and ethylene and propylene glycols. One of the most alluring possibilities is synthetic ethyl alcohol (see *Chem. & Met.*, June, 1929, pages 329 and 388). Direct synthesis from ethylene and water is entirely possible from a thermodynamic standpoint and awaits only the discovery of an effective catalyst to make it the basis of a \$50,000,000 industry.

In discussion of the availability of raw materials, Dr. B. T. Brooks made the statement that as much as 800 tons of ethylene a day is now being produced by the installations of a single vapor phase cracking process. R. T. Haslam, of the Standard Oil Development Company, agreed with the authors in the view that the ultimate development of synthetic solvents would be carried on by a separate chemical industry, which would be supplied with raw materials by the petroleum refiner.

Amyl alcohols to the extent of thousands of gallons per day are being manufactured from pentane at the Belle (W. Va.) plant of the Sharples Solvents Corpora-

tion, according to a paper presented by Eugene E. Ayres. In this plant, which was described in *Chem. & Met.* in May, 1927, 22 tons of chlorine per day is being fed continuously into a 60-mile per hour stream of hot pentane vapor. Although 100,000 gal. of pentane passes through the reaction zone every 24 hours, only 3 gal. of pentane and 8 oz. of chlorine are in direct contact at any given moment. This is because of the tremendous speed of the reaction, which is completed in  $2\frac{1}{2}$  seconds.

Mr. Ayres described some of the remarkable results that were obtained in first putting the process into actual practice. An interesting sidelight was that despite the fact that large volumes of HCl are handled in metal equipment, none of the five iron distilling columns has shown any evidence of corrosion during more than two years of operation. Mr. Ayres attributes this to a peculiar property of Toncan iron (an iron alloy containing copper and molybdenum) in being preferentially wetted with pentane or amyl chloride rather than with the aqueous acid—while exactly the reverse is true with ordinary iron or steel.

**F**ERMENTATION methods still play the most important part in solvents production, according to a paper prepared by F. M. Crawford, of the Commercial Solvents Corporation, and read in his absence by Charles Lichtenberg, of the same organization. Starting in 1920 with an output from only a few fermenters, the demand from the lacquer industry for n-butyl alcohol has increased by leaps and bounds until in 1929 approximately 150 fermenters, each of 50,000-gal. capacity, are required to keep up the required rate of production. The original plant capacity at Terre Haute, Ind., was soon outgrown and a second and a short time later a third plant were built. The latter two are at Peoria, Ill.

During the fermentation, tremendous quantities of gases consisting of a mixture of approximately 40 per cent of hydrogen and 60 per cent of carbon dioxide, are given off. In fact, more than half of the carbohydrate entering into the fermentation process goes into the formation of these materials, which at the Peoria plant are being converted into synthetic methanol.

After tracing the remarkable growth in the production of nitrocellulose lacquers and the corresponding decrease in the costs of the aliphatic chemicals and solvents that enter into their formulation, J. G. Davidson, of the Carbide & Carbon Chemicals Corporation, demonstrated the properties of some of the most interesting of the newer synthetic resins. For more than two years his company has been working on the polymerized vinyl compounds, which are of particular interest in lacquers because they dry in a similar manner to paint and var-

nishes—that is, by polymerization rather than solely by evaporation, as is the case with lacquer. This means that more film-forming constituents may be left on the surface than with lacquers. Thus while the total solids in a lacquer rarely exceed 25 per cent, in varnishes and paints and likewise in vinyl resin lacquers, it is possible to reach 50 to 60 per cent of total solids.

Lacquers made with the vinyl resins are waterproof, according to Mr. Davidson; remarkably resistant to acid or alkali and can be produced in any colors. The same resins which are to be known by the trade name of "vinylite" are thermoplastics and can be molded with or without fillers in any colors, including ivory white. They appear also to have advantages in impregnating fabric, paper and wood. Their development marks the beginning of a steady evolution through which the lacquer industry will grow to increased size and economic importance—largely as a result of parallel developments in the field of synthetic aliphatic chemistry.

Prof. A. H. White of the University of Michigan, president of the Institute, presided at the distillation symposium, at which six papers were presented. Dr. N. E. Loomis, of the Standard Oil Development Company, read a paper prepared in co-operation with R. S. Piroomov which discussed design problems of flash distillation equipment in the petroleum industry. It described a method of predicting the equilibrium flash characteristics of various petroleum stocks and the application of this method to the design of refinery equipment. This paper will be published in full in an early issue of *Chem. & Met.*

H. M. Weir and R. B. Chillas, of the Atlantic Refining Company, Philadelphia, also discussed the design of fractionating columns, outlining the primary considerations involved in columns of the plate and bubble-cap type. They believe that the trend of column design in the future will be in the direction of smaller diameter and higher vapor velocity for a given throughput. Columns to be operated at very high pressure or at very greatly reduced pressure can be designed to obtain surprisingly high vapor velocity if proper attention is given to the design of the plate.

**A**NOTHER of the fundamental studies of distillation which is being carried on at the University of Michigan under Prof. George Granger Brown was reported in a comprehensive paper which he had prepared with Marvin C. Rogers. This discussed Raoult's law in relation to the designing of absorption and stabilizing equipment such as is used in the natural gasoline industry. The authors confirmed by quantitative study the general assumption that this law could be satisfactorily used in engineering calculations where an accuracy of 5 to 15 per cent is permissible. When greater accuracy is desired, it appears that little confidence can be placed in results calculated by means of Raoult's law.

The paper by Arthur A. Backhaus, vice-president of the U. S. Industrial Alcohol Company, described the glass plate distilling columns developed by his company in co-operation with the Corning Glass Works. This paper appears on page 429 of the present issue of *Chem. & Met.*

H. R. Swanson and J. B. Blizzard, of the Foster-Wheeler Corporation, discussed furnace design and heat recovery in relation to the economical operation of modern pipe still installations. The importance of heat conservation is evident from the fact that the cost of fuel represents approximately 65 per cent of the total direct

operating costs exclusive of fixed charges. The four principal energy losses are: (1) Those caused by radiation and convection from the outside of the equipment, (2) the heat remaining latent in the steam formed from the fuel, (3) the sensible heat in the escaping gases and (4) the loss due to combustibles in the same gases. In general the recent trend of design on the part of all engineers has been dictated by the demand for more adequate provision for the absorption of radiant heat in order to permit operation with small quantities of excess air and also insure low flue gas temperatures.

**M**OST interest in the symposium centered in the informal discussion of the Govers process for refining lubricating oils. A. E. Wells, consulting engineer, of Cambridge, Mass., read a preliminary paper on the use this process makes of diphenyl as a heating medium in distillation, and Dr. Francis X. Govers, director of research for the Indian Refining Company, answered questions and demonstrated the operation of the process. The problem of producing a special grade of lubricating oil distilling between 485 and 625 deg. F. called for the use of an indirect heating medium. After considering various low-melting metals, mercury and sulphur vapors it was decided to use diphenyl, which has a vapor pressure of 110 lb. at a temperature of 750 deg. F. There is apparently no decomposition at this temperature, for Dr. Govers reported that when used continuously in their apparatus for over six months, the make-up amounted to less than  $\frac{1}{2}$  per cent. Diphenyl produced for this process on a commercial scale for the first time by the Federal Phosphorus Company, of Birmingham, has a melting point of 158 deg. F., a boiling point of 484 deg. F., and a specific heat of 0.4. Its thermodynamic properties are being studied at the University of Michigan and elsewhere and will shortly be published.

In the Govers process the diphenyl is vaporized in a tubular heater similar to a modern boiler and the vapors pass to a single-effect vacuum evaporator where a mineral oil fraction between 485 and 625 deg. F. is volatilized and taken off in an overhead condenser. Pressure in the still is about 5 mm. It is reported that with a waste heat boiler the entire process has shown a thermal efficiency of 83 per cent. The Govers process, which includes solvent extraction of paraffin and certain other features, will be discussed shortly in a paper being prepared by Professor Wells.

At the final technical session on June 21 Prof. D. S. Chamberlin, of Lehigh University, reported on a study made with Arthur Rose of the factors involved in the formation of carbon black from natural gas. They showed that for a given gas and tip, the maximum possible yield is reached at rather a low rate and further increase in the rate results in a less efficient flame. For any given flame the maximum yield is obtained when the plate height equals the flame height, which is determined by the rate, pressure, tip and atmosphere. The color of the black varies with the tip and pressure of the gas but is independent of rate, atmospheric condition, moisture content of the gas, and the temperature, motion and material of the plate.

Gas absorption held considerable interest as a result of a paper on the mechanism of film formation by J. H. Monaweck and E. M. Baker, of the chemical engineering department of the University of Michigan. By a quantitative study of gases during the first few seconds of contact with solvent liquids, these authors were able to show that liquid and gas concentration films at the inter-



face offer the principal resistance to absorption. It followed from their discussion that practical absorption apparatus which constantly creates new contacts between the gas and liquid phases and thus minimizes the opportunity for gas and liquid films to form will be especially effective. A period of 3 to 5 seconds should be the maximum for prolonged contact.

Papers presented by Dr. Chas. W. Cuno, on the "Migration of Industry," and by Dr. A. M. McAfee, on the "Manufacture of Commercial Anhydrous Aluminum Chloride," are to be found elsewhere in this issue.

## Industries and Schools Confer on Engineer's Education

THE THIRD conference on chemical engineering education was held in Philadelphia, June 22, under the auspices of the American Institute of Chemical Engineers. In opening this meeting H. C. Parmelee, chairman of the Institute committee on chemical engineering education, recalled that the first conference, held in Brooklyn in 1922, concerned itself with matters of definition; the second, at Columbia University in 1926, dealt with problems of administration, while the present session was called primarily to consider the underlying philosophy of actual operations. A happy commentary on the session as a whole was that the fundamental conception of chemical engineering as advanced in the previous conferences had been so universally accepted that no time was lost in needless controversy over matters of definition and details of organization.

Prof. Harry McCormack, of Armour Institute, opened the discussion on the purpose and use of the chemical engineering laboratory and presented an excellent summary of present conditions. He showed how the laboratory should clarify and expand the textual principles. He then outlined an idealistic course, citing typical experimental procedures. In discussion, Curtis, of Yale, emphasized the value to be gained from such a survey of conditions in other institutions. Sherwood, of Worcester; Uhlman, of Lehigh; Maston, of N.Y.U.; Badger, of Michigan; Dean Moore, of Purdue, and C. C. Heritage, of the Forest Products Laboratory, contributed to a lively discussion of various aspects of the laboratory problem. There was general agreement on the necessity for emphasizing fundamentals, but some disagreement on method.

Prof. W. K. Lewis, of Massachusetts Institute of Technology, spoke to the assignment "Introducing the Student to Industrial Work." The old idea of getting a man a job and then letting him "sink or swim" is being replaced by a desire to help him in making the transition step as easy as possible. The only effective means of training a man to do a job is to let him do it and under conditions comparable with those met in industry. This was first brought home to M.I.T. by experience with summer jobs and it led eventually to the school of chemical engineering practice. Dr. Lewis concluded his remarks with an appeal to the teachers of chemical engineering for a better recognition of the seriousness of their obligation in training men who are morally and physically as well as mentally equipped to solve the complicated problems of present-day civilization.

H. C. Pfeffer, of Purdue, described the elaborate sys-

tem of personal rating and character analysis employed at his institution. Beginning with the orientation tests on the freshmen, who are studied for aptitude along the lines of chemistry, engineering, English and reading, the scheme of personality and character rating is carried on throughout the entire four-year course. As conducted the analysis is entirely impersonal and is believed to be more valuable for this reason.

ECONOMICS' place in the chemical engineering curriculum came in for much constructive discussion. Prof. Harry A. Curtis, of Yale, pointed out that without minimizing the importance of the technical tools given the student, it should be recognized that they can be used only in solving problems that are essentially economic. Departments of economics in most universities are not equipped to give the kind of instruction the chemical engineer requires and for that reason many chemical engineering departments have developed their own courses. At Yale this course is placed in the graduate school, but under a special option is elected by about 90 per cent of the seniors in the department. The course includes such studies as the following: (1) Characteristics of chemical engineering industries, (2) raw materials, (3) political and legal considerations, (4) patents and trade marks, (5) plant location, (6) construction materials, (7) economic choice of equipment, (8) unit operation costs, (9) industrial organization, (10) management problems and (11) project feasibility.

Webster N. Jones, general superintendent of the processing division of the B. F. Goodrich Company, presented industry's viewpoint in a paper, "The Rubber Industry's Appraisal of the Chemical Engineering Graduate." That appraisal, apparently, is very high, for Mr. Jones showed that in the larger rubber companies in Akron there is an increasing proportion of new men with this type of training. One company has employed 57 chemists and 60 chemical engineers since Jan. 1, 1925. In 1925, of 16 men with chemical training, but 6 were chemical engineers. Last year, 32 men were employed and 19 were chemical engineers. "Chemical engineers are being selected," he said, "for their adaptability not only to materials, engineering and process development but also to purchasing and sales organizations and to executive work of all descriptions."

"Mathematics for Chemical Engineers" was competently discussed by Theodore R. Running, professor of mathematics at the University of Michigan. Because he is closely associated with the chemical engineering department—in fact, has his office in that building—Professor Running shares to an unusual degree in the chemical engineer's viewpoint.

The final discussion, led by Arthur W. Hixson, professor of chemical engineering at Columbia, concerned the character of post graduate work. He held that only courses of an advanced character competently taught to men who have completed work for their first degree are entitled to post graduate classification. Such courses must be an extension of undergraduate work, but must give more intensive study than is given in any previous course. As typical of such advanced study, Professor Hixson outlined the courses given at Columbia in process development and chemical plant design.

In concluding the conference the chairman stated that all of the papers as well as the discussion would appear in a published report which would be made available to the various universities through the office of the secretary of the Institute.



# Comparison of Modern Chamber Sulphuric Acid Plants

By Thomas R. Harney

Superintendent, Acid Division  
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MR. HARNEY wishes to emphasize the fact that he has acted entirely without personal bias in assigning merit ratings to various types of plant. The data used throughout the paper were derived from calculations made for his own information and in order that he might answer intelligently when asked by officials of his company to evaluate something new in the way of acid-making equipment. As a matter of fact, some of the conclusions to which he was forced were as surprising to him as they may be to others. For this reason he took particular pains to check calculations pertaining to special types of plant with which he has had no personal experience. Unfortunately, published data upon some of these types are scanty, so that certain assumptions and estimates have had to be made. In these cases, criticism by experienced operators of such plants will be welcome and the author will gladly acknowledge any error of consequence arising from lack of information.

The writer states that this is particularly true of the Gaillard system, in the evaluation of which quantitative data could be obtained from only one published article. This system seems to possess considerable merit and it is entirely possible that additional information will show the necessity for a rerating of the Gaillard plant—especially information in regard to maintenance cost over a period of years for a plant without brick lining walls.—EDITOR.

**"MODERN"** is a word having many meanings and many connotations, but when applied to chamber sulphuric acid plant operation it is almost uniformly translated "intensive," so it is primarily of intensive chamber operation which I intend to speak. Dr. Lunge seems to have started the ball rolling—as he started many other things connected with acids—by the introduction of his plate tower. As is usual upon the introduction of something new, the experts disagreed, and Lunge and Rashig and Hurter and Sorel and McTear and numerous others argued theory and practice to their hearts' content—and to the great edification and education of those who followed them, for they argued in print with a recklessness which is not common in this age of "safety first."

After Lunge, inventions came thick and fast. Peterson's regulator, Gilchrist's pipe towers, Pratt's converter and various other pieces of equipment designed to increase reaction velocity, when used in connection with chambers, were typical of one line of endeavor; chambers of various special shapes, such as Moritz' tower chambers, Meyer's tangential chambers, and Falding's high chambers, represented the school of design which believed success lay in that direction; while the Opl and Griesheim tower plants were the results of the efforts of those who sought to do away entirely with chambers.

All three classes are today represented by outstanding examples of their various types of equipment. The

Schmiedel box is the present offering of the devotees of auxiliary equipment; the Mills-Packard chamber holds the limelight on the stage where the chamber shapists perform; and the Gaillard spray tower chamber carries the hopes of the chamber eliminationists. To the best of my knowledge there has not been a modern analysis of the merits of these systems, comparing them with standard chambers, and observing them from a disinterested viewpoint. It is such an analysis and comparison which I hope to make herein. In order to forestall possible question of the disinterestedness of my stand, since I am the at-one-time-proud parent of an "intensive" system, I shall state that to date my invention seems to have certain plant-scale limitations and I hold no brief for it beyond those limitations.

In making an analysis and a comparison it is necessary first to adopt a standard, or a metric, as the physicists say, which can be applied to the objects under consideration. In this particular case the ideal means of comparison doubtless would be dollars of plant construction cost per ton of 100-per cent acid per day, modified by a factor representing operating and maintenance costs per ton. Unfortunately, the data for the establishment of such a standard are not available. Estimates of probable construction and operation costs would offer such excellent ammunition for criticism that I hesitate to attempt them.

Another possible standard is the hoary criterion of "cubic feet per pound of sulphur," but such a measure is really meaningless except when applied to pieces of equipment which are identical, or at least similar, in design. Space, *per se*, whether it be Euclidean or non-Euclidean, is relatively inexpensive. The investment arises when space is inclosed, and I believe the data that follow will show that cost is by no means directly proportional to the space inclosed in the case of acid-making equipment.

Therefore, since I cannot give construction and operating costs and since the conventional cubic feet ratio is not a true measure of relative merit, I have chosen as my basis of measurement the square feet of radiation surface, or perhaps, since we shall discuss certain types of equipment in which the radiation of heat presumably is not important, I shall say square feet of wall and roof surface, required per pound of sulphur per day.

Partly from my own experience and partly from standard publications, I shall give this ratio for the following types of plant: (1) modern standard chambers; (2) chambers with intensifying auxiliary equipment (3) chambers of special shapes; and (4) plants without chambers. In conclusion I shall summarize and venture a personal opinion as to the ideal plant for the manufacture of sulphuric acid by the nitration process.

**Modern Straight Chamber Operation**—Prior to 1915, so far as my knowledge extends—which for that period means principally the literature of the subject—the best American straight chamber practice contemplated a rate of production corresponding to 1 lb. of sulphur per 24 hours to each 14 or 15 cu.ft. of actual chamber space. In terms of our surface measure this would mean about 2.44 to 1.88 sq.ft. per pound of sulphur per 24 hours when applied to the five straight chamber sets with which I have had personal experience.

When war-time demand required immediate increase in acid supplies many companies simply increased the production of their plants by supplying more gas to the chambers, thus doing something which experts said could not be done. When these experts saw that it could be done, they were ready at once with an explanation. It was possible, of course, they said: It was a very simple matter of increasing the nitre-sulphur ratio, but it *shouldn't* be done. It would cause serious and rapid deterioration of the chamber walls. (Some said the first chamber and some said the last.)

**D**URING the 14 years that have elapsed most plants have continued intensive operation, and the gloomy prophecies of the opponents of the method have not materialized. In view of the higher chamber temperatures obtaining and of the increased nitrosity of the chamber gases it is probable that deterioration of lead is more rapid under intensive operation, but 14 years' experience has shown that any increased cost of maintenance is much more than offset by reduction in labor and investment charges.

The tabulation of data in Table I shows the earliest and the latest in my own experience with intensive operation of straight chamber sets. Sets shown under *A* were operated during the years 1916 and 1917. Primarily they were intended to handle the gases from Hegeler zinc roasting kilns and were rated at 50 tons of 60 deg. Bé. acid per day. By burning sulphur this production was raised to 65 to 70 tons of 60 deg. acid per day. I am informed that operation has now been improved in regard to nitre consumption, although I believe not in the matter of production.

The data shown under *B* represent post-war operation of a very efficient plant. In so far as size of chambers is concerned, it is a standard chamber set, but it is constructed without studding or crown plate, so that virtually each square inch of its curtains and top is available for the radiation of heat.

It is interesting to observe that were these sets to be compared on the basis of cubic feet per pound of sulphur it would be shown that the *A* sets were only 23 per cent behind *B* sets, whereas on the square-foot basis they are 33 per cent behind. Below there will be shown, in another connection, data from an exhaustive study of *B* set.

**Sets With Intensifying Auxiliary Equipment**—Ever since the beginning of the present century there have been in operation in the southern part of the United States chamber sets of a type which met, as a regular thing, all the claims of the intensive method of operation. The basic patent on Pratt chamber sets expired in 1912

Table II—Special Chamber Sets

Set	No.	Source of Sulphur	Chamber Space Cu.Ft.	Cooling Area Sq.Ft.	Ave. Lb. S per Day	Cu.Ft. per Lb. S	Sq.Ft. per Lb. S	Per Cent NaNO <sub>3</sub> on S
<i>C</i>	Pratt	Brims.	610,000	81,027	58,000	10.50	1.40	2.0
<i>D</i>	Pratt	Brims.	113,000	20,200	19,000	5.95	1.06	5.0
<i>E</i>	Pratt	Brims.	199,000	29,000	30,000	6.63	0.965	5.0
<i>F</i>	Straight*	Brims.	280,000	44,400	33,000	8.50	1.35	4.5
<i>G</i>	Straight†	Pyrites	315,000	45,000	29,000	11.25	1.61	3.25

\*2 Intertowers, Brick-packed

†2 Intertowers, Brick-packed and 1 Pipe Tower

and why this best of American systems has obtained so little recognition in the North is something of a mystery. Perhaps it was due to lack of advertising; perhaps to an only partly merited reputation for being "nitre hogs." The standard Pratt set has only one Gay-Lussac tower and experience with four of them indicates that while a skilled operator can get good nitre recovery, average nitre consumption is slightly higher than with the straight set. The addition of another tower would overcome this criticism and still leave the Pratt set less expensive in construction than a straight set of the same capacity.

For the benefit of those not familiar with the Pratt system I insert the following brief description. Pratt sets consist of a very large first chamber containing between 70 and 75 per cent of the total chamber space. A part of the gas passes straight through this chamber into short flues at the rear and enters a small quartz-packed "converter" tower. Upon leaving this tower the gas returns to the fan intake and is forced again into the first chamber. The gas exits from the first chamber are flues, one on each side, which lead from the forward corners of the chamber, well toward the top, extend the full length of this chamber on the outside and enter the second chamber, which is placed behind the converter tower.

The remaining chambers are small, and are two or three in number, depending upon the size of the plant. The Glover tower, first chamber, and converter tower are expected to produce 90 per cent of the total production and this expectation usually is met in practice. Wherever possible, Pratt plants are built in a straight line, that is, with the last chamber exit at the farthest possible point from the Glover and Gay-Lussac towers, which are adjacent to the burners, and the long connecting flue has an important bearing on the efficiency of these plants, serving as a gas cooler between chambers and Gay-Lussac tower.

Aside from Pratt converters, the only auxiliary equipment which has had any extensive application in the United States consists of intermediate towers of various sorts. Some of these are small packed towers, usually operated without acid circulation, and some are "pipe" towers of the Gilchrist or Marlowe type, intended only for cooling and mixing the gas. Both types seem to do substantially what their designers claim for them—i.e., give a high rate of operation per cubic foot of space.

Table II shows results obtained in the operation of chamber sets having auxiliary equipment. Some interesting figures may be derived from this table by comparing the relative cubic-foot and square-foot ratios of the various sets. From the cubic-foot ratio, set *D* appears the best, but when the ratio is changed to square feet of lead surface, set *E* proves to be the most economical.

Plant *C* was operated just at the end of the war and was never brought up to maximum production. The data are interesting only in showing what a Pratt plant can do in the way of nitre consumption when operated

Table I—Straight Chamber Sets

Set	No.	Source of Sulphur	Chamber Space Cu.Ft.	Cooling Area Sq.Ft.	Ave. Lb. S per Day	Cu.Ft. per Lb. S	Sq.Ft. per Lb. S	Per Cent NaNO <sub>3</sub> on S
<i>A</i>	Ave. of 4 sets, all alike	Blende— and — Brims.	350,000	57,000	37,000	9.50	1.54	4.5
<i>B</i>	1	Brims.	370,403	52,476	50,941	7.27	1.03	3.0



at a cubic-foot rate of production considered near the maximum for other contemporary chamber plants.

Plants *D*, *E*, and *F* were operated during the immediate post-war period, when production rather than efficiency was the aim and when the American laborer was King. These two points explain high nitre consumption, at least in part.

Plant *G* also was operated after the war, but somewhat later during a period of reason. The limiting factor in its production was a deficiency of Gay-Lussac and Glover-tower space, as the chambers and intermediate towers were not loaded at the rate shown above. All the foregoing data are taken from my own records.

**Chambers of Special Shape**—In this section I shall be obliged to depend upon published operating data on chambers of special shapes. Since tabulation of data obtained from standard works on the subject consists merely of calculations which anyone interested may make for himself, and since in this class only the Mills-Packard chambers are of present interest in this country, I shall confine myself to this type of chamber. The omission of Meyer, Falding, and Moritz chambers is intended in no way as a reflection on the merits of these systems.

**MILLS-PACKARD** chambers are the only actual chambers in which exterior water cooling has been successfully worked out. In design they are essentially truncated cones with a series of leaden troughs, from six to eight in number, burned circumferentially to the curtains at vertical intervals of 6 to 7 ft. These troughs serve as distributors for the cooling water.

Table III is taken from data derived from an article by W. G. Mills, in "Transactions—Institution of Chemical Engineers," Vol. 5, 1927. In calculating square feet of lead surface, the area of the sides and tops of the chambers, plus the area of connecting flues, plus the area of lead in the distributing troughs, was taken. There is, of course, no question about the flues, as they also are included in calculations of other types of chambers. The troughs are a basic part of this type of chamber and since such chambers require distributing troughs of lead, it is felt that their inclusion as lead surface is fair.

**Equipment to Replace Chambers**—Some advocates of Lunge's plate towers believed that this equipment could be used alone—not in combination with chambers—to considerable advantage from the point of cost. Later, however, most of them came to the conclusion that this was not feasible.

To Opl, therefore, belongs the credit for the first technically successful system replacing the chambers with other apparatus. His system consists usually of from six to eight packed towers (this may be extended to ten or twelve) over which acid of various sorts is circulated. According to Opl himself (from Wilfred Wyld, "Manufacture of Sulphuric Acid," 1924, p. 81) a typical system consists of six towers of which the first three make acid and the last three recover nitre.

Griesheim towers and Larison's packed-cell plant are in general similar to Opl's system. Details of acid

Table III—Mills-Packard Sets

Set	Source of Sulphur	Chamber Space Cu.Ft.	Lead Area Sq.Ft.	Ave. Lb. S per Day	Cu.Ft. per Lb. S	Sq.Ft. per Lb. S	Per Cent NaNO <sub>3</sub> on S
A	Brims.	150,000	38,288	38,420	3.90	0.987	2.66
B	Brims.	36,650	11,292	11,270	3.25	1.008	2.00
C	Pyrites	21,930	8,124	6,000	3.67	1.35	2.86
D	Spent Oxide	43,980	16,248	12,560	3.50	1.29	2.01
E	Pyrites	71,340	22,584	16,390	4.35	1.38	4.06

Table IV—Tower Sets

Set	Type	Source of Sulphur	Chamber Space Cu.Ft.	Lead Area Sq.Ft.	Ave. Lb. S per Day	Cu.Ft. per Lb. S	Sq.Ft. per Lb. S	Per Cent NaNO <sub>3</sub> on S
A	Opl	Pyrites	15,250	7,820*	9,470	1.61	0.826	1.62
B	Opl-Wyld	.....	7,200	6,730†	9,270	0.78‡	0.726	.....

\*200 ft. of 24-in. flue (est.) included.

†250 ft. of 24-in. flue (est.) included.

‡This figure does not agree with the 0.6 cu.ft. per lb. of sulphur which Wyld gives as his rate of operation. Doubtless in making his calculation he based his figures upon the volume of his towers, exclusive of lining walls, but since he does not give the thickness of the walls the calculation can not be made.

circulation and of construction differ, but the effectiveness of the systems is due to the factors mentioned.

OPL describes a six-tower unit for producing 18 tons per day of 60-deg. acid (*Chem. Ind.* 1914, p. 523) and the essence of his description is given in the reference in "Manufacture of Sulphuric Acid," mentioned above. Data for *A* in Table IV were derived from this description. In order to provide a fair comparison of this tower system with chambers, it is assumed that four towers are utilized in producing acid, since at most but two towers would be used for a chamber plant of equal capacity. The third tower therefore is an inherent part of such an acid-making system, just as distributing troughs of lead are unique in the Mills-Packard chambers. Data for *B* were derived from the same reference, page 83, and pertain to a tower set described by Wyld as being successful in operation.

The Gaillard tower or tower chamber is a rather interesting development, in that it depends for its success upon cooling through the walls and also upon cooling by the circulation of cooled acid. That is to say, it utilizes both chamber and tower principles. Essentially, the Gaillard system (*Chem. & Met.*, Feb., 1929, p. 68ff.) consists of one or more void tower chambers (i.e., chambers in which the greatest dimension is vertical) combined with Glover and Gay-Lussac towers which also may be void, except perhaps for the final Gay-Lussac tower.

Chamber acid is withdrawn from the chambers, cooled to about 20 deg. C. and sprayed into the chambers at the top. The means of spraying is a piece of apparatus described as a "turbo disperser." This consists essentially of a motor-driven wheel, similar to a closed type centrifugal pump impeller. This apparatus is so set that the turbine wheel is inside the chamber, with its shaft vertically disposed, and with the motor carried above the chamber top. Acid (or acid and water) is fed to the wheel, so that when the latter is rotated rapidly, acid droplets are widely dispersed throughout the chamber atmosphere.

It is stated that the disperser may also be applied to existing chambers and that so applied it has increased production by as much as 25 to 50 per cent. In the example given of such increase, previous operation was at an "intensive" rate, based upon cubic feet of chamber space per pound of sulphur. Table V, covering two tower-chamber sets, is derived from data given by Percy Parrish in the above mentioned article.

There remain two other types of equipment of modern

Table V—Gaillard-Parrish Plants

Set	Source of Sulphur	Chamber Space Cu.Ft.	Lead Area Sq.Ft.	Ave. Lb. S per Day	Cu.Ft. per Lb. S	Sq.Ft. per Lb. S	Per Cent NaNO <sub>3</sub> on S
A	Pyrites	53,800	12,040	14,900†	3.61	0.809	.....
B	Pyrites	59,900*	13,650	20,360	2.94	0.671	2.25

\*This figure does not agree with the "effective capacity" of 52,930 cu.ft. for the set as given in the article (p. 72). Chamber sizes are given as 19 ft. 8 in. diam. by 49 ft. 3 in. high, and the number of such chambers is given as four. It is possible that there is a lining wall of brick in these chambers, through the article does not say so.

†It was stated that this rate of operation was much exceeded.



Table VI—Ratings Based on Cooling Surface

Type	Sq. Ft. of Cooling Surface per Lb. of S per Day	Comparative Rating (Best = 1.0)
Schmiedel box.....	0.57—0.628	1.0—1.1
Flue system.....	0.60	1.05
Gaillard tower chamber.....	0.671—0.809	1.18—1.42
Tower systems.....	0.726—0.826	1.27—1.45
Pratt chamber sets ( <i>D</i> and <i>E</i> , table II).....	0.965—1.06	1.69—1.86
Mills-Packard.....	0.987—1.38	1.70—2.42
Modern straight chamber set ( <i>B</i> , table I).....	1.045	1.83

design which were originally intended to replace chambers. The first of these, both in point of time and in point of number of installations, is the Schmiedel box. This is a lead box, usually about 20 ft. long by 6 ft. wide by 3 ft. high. Two or three hard lead or cast-iron fluted "rollers" about 8 in. in diameter are placed in each box. These rollers are mounted transversely in the box, with outside bearings, and are revolved at about 600 r.p.m. Acid level is kept sufficiently high to insure the rollers being partly submerged.

The roller is in fact a device for creating in the box an atmosphere of acid spray, just as the turbo disperser does in the Gaillard tower chamber. Essentially, therefore, the two systems work on the same principle—that is, upon the exposure of a very large surface of acid (the surfaces of a large number of minute droplets) to the gases in the system. Cooling is obtained by the circulation of cooled acid and by heat loss through the walls of the boxes.

**AREA** calculations, based upon data of Bush and Grounds ("A Note on the Function of the Schmiedel Box in the Manufacture of Sulphuric Acid." *Trans. Inst. of Chem. Engrs.*, Vol. 5, 1927, p. 34), show the two box systems they describe, including towers said to be necessary, to have operated at 0.628 and 0.57 sq. ft. of lead per pound of sulphur. In this figure no allowance is made for lead in rollers. The authors of this article (on p. 39) have this to say of two installations of Schmiedel boxes, operated as complete plants: "At neither of the above two plants have the boxes come up to the expectations attached to them, and manufacturing experience, assisted by careful chemical tests, showed that the view of the originators that a series of boxes could entirely replace chambers was erroneous." They point out, however, that the Schmiedel box has been successful in handling metallurgical gases which are relatively cold and which have very wide and rapid fluctuations in  $\text{SO}_2$  content. This is claimed for no other generally known acid-making equipment.

The other system mentioned is the so-called "Flue System," invented by the writer, which consists of a series of water-cooled, return-bend flues, arranged in banks of four flues, each approximately 30 ft. long—that is, a total of about 120 ft. of flue per bank. There may be two or more banks, depending upon the size of the plant. At the end of each bank, so that the gases pass through it in going to the next bank, is a small packed tower, which may or may not be irrigated by acid circulation. This type of system will run at the rate of about 0.6 sq. ft. of lead surface per pound of sulphur, including flues and towers in surface calculations.

**Summary and Comments**—From the foregoing data Table VI is derived to show comparative rating on the square foot/pound sulphur basis of various types of chamber equipment. The table is interesting. In format it represents exactly the aim of the writer when this article was first conceived—that is, a concise, quantitative statement to which the non-specialist could go

for information. Unfortunately, it has not been found possible to construct a table which can be so used. The figures in the final column are all affected by certain variables which seemingly cannot be stated quantitatively. These variables have to do with: Cost of the particular type of surface; ease of operation; relative freedom from maintenance costs; ground space available.

From personal experience it seems probable that by the summation of the first three factors mentioned, one would arrive at a value of the nature of

$$F = (f) \frac{1}{R} \text{ where } F \text{ is the factor to be applied to } R,$$

the comparative square foot/pound sulphur rating. This statement of inverse variation may be questioned in the matter of cost of surface, since in certain cases the small equipment may be less expensive per square foot than the larger, and in the matter of maintenance, since external water cooling as practiced in two of the systems included might conceivably lengthen the life of the lead, but in the matter of ease of operation it almost certainly is true.

One consideration only is necessary to prove this point: If more sulphur dioxide per day per square foot of lead be converted to sulphuric acid in one system than in another, then the velocity of gas passage usually is greater through the first system than through the second, while the time of complete change of chamber atmosphere is less. That is, whereas the ordinary chamber sets of average size may require from one to three hours for a change of gas from front to rear, Pratt sets require from 30 to 35 minutes and flue systems from 5 to 6 minutes. In these three systems the inverse variation, in regard to ease of operation, holds true. That is, the Pratt set is slightly harder to operate than the straight set, though the difference is not serious.

**THE** cost of surface of various kinds finds its chief application in the consideration of towers versus chambers. With the exception of Gaillard towers, such equipment usually is packed with a more or less expensive material. So important is this added item of cost that in spite of the small amount of lead involved (roughly one-sixth of the total), Glover and Gay-Lussac towers when properly designed, usually represent about one-third of the total equipment cost of the ordinary chamber plant.

Except for the lining wall, which is said to be necessary with Gaillard chambers in case nitrous vitriol is to be circulated (and which would seem to be desirable in any case if considerable quantities of sprayed acid are to run down the inner walls of the chambers), surface for this type of plant, for the Schmiedel box, and for the flue system should cost no more than ordinary chamber surface. The two latter types of plant might conceivably cost less per square foot of lead (for the lead alone) and the flue system has the further advantage that *all* lead in it is cooling surface, whereas in chambers of all types, in towers, and in Schmiedel boxes, bottom lead was not counted as cooling surface. Flues and Schmiedel boxes, however, require towers in connection and the Schmiedel box has the additional item of rollers and driving mechanism.

Bush and Grounds, quoted above in connection with Schmiedel boxes, draw the conclusion that this equipment is most effective when used with reaction towers or chambers. That is to say that the Schmiedel box is in reality to be classed with equipment for the in-

tensification of reaction in other types of plant, rather than as a replacement for chambers, as the inventor intended. Speaking from my own experience with my invention, the flue system, I can say that the same thing appears to be true of it. Standing alone as a unit, the flue system, while it is possible to obtain in it conversions equal to those obtained in other types of equipment and with adequate Gay-Lussac capacity (greater than that needed for chamber plants) to operate with only normal nitre loss, is so unstable in operation that its value, without further development, seems doubtful. It is probable that the same is true of the Schmiedel box.

Realizing that proponents of various systems may well be able to advance valid arguments in refutation of my statement—especially arguments which will be valid for specific cases—I venture the following as my own rating of the over-all merits of systems which are covered in this paper. In assigning these ratings I have attempted to evaluate the factors to be applied to the third column of Table VI, but some of the variables involved are so intangible that I hesitate to offer any numerical factor. Hence, I simply assign relative standings from 1 to 5.

Standing	Types of Equipment
1	Pratt Chambers
1	Mills-Packard
2	Modern chamber set with intermediate towers
3	Gaillard Tower Chambers
4	Tower System
5	Schmiedel Box
5	Flue System

Mills-Packard and Pratt sets are put on the same footing, despite the slightly lower square foot/pound sulphur ratio of the latter. The wider use of Pratt chambers extends available information on their performance under all conditions and gives more accurate data on maintenance costs. Also it is doubtful whether the figures given in this paper represent maximum Pratt capacity with Gay-Lussac space more in accordance with modern chamber practice. On the other hand, Mills-Packard chambers require no housing, which reduces over-all cost of plant.

The least defensible classification above probably is the placing of Gaillard chambers third in the list. This was done on account of the uncertainty of the necessity for a lining wall, which, if it be required in order to protect chamber lead, which seems probable, would greatly increase cost of erection, and because, from the standpoint of maintenance, moving parts, such as the Gaillard turbo-disperser and the Schmiedel roller, offer at least the possibility of trouble.

The tower system is placed fourth on account of probable cost of construction in this country. The flue system and the Schmiedel box are rated together in the last position on the theory that in their present state of development they are really to be classed as auxiliary intensifying equipment rather than complete plants, except in special instances where conditions are unusual.

*The Ideal Chamber Plant*—Before proceeding to describe my ideal in chamber plants I shall mention certain data obtained in the detailed study of reaction velocity in a going plant. This was a straight chamber set (B, Table I) without intermediate towers, but with an exceptionally good Glover tower and with rather more than the average amount of Gay-Lussac tower volume, though the latter did not exceed the amount which might profitably be included in any chamber plant. During

Table VII—Reaction Progress, Straight Chamber Set

Percentage of Total Chamber Cooling Surface	Percentage of Conversion	Sq. Ft. per Lb. S
22.2	43.20	0.514
38.4	61.03	0.632
51.9	75.96	0.683

the three weeks of this study the limiting factor in production was blower capacity, so that it cannot be said with certainty that the figures I shall give represent absolute maximum capacity of the other equipment. Reaction velocity was determined by hourly gas analyses at the entrance and exit of each element of the chamber set—Glover tower, flues from tower to chambers, chambers, and so on—96 consecutive hourly tests being taken at each point, and two adjacent points (i.e., entrance and exit of an element) being always under observation at the same time. Percentage of SO<sub>2</sub> in the gas entering the Glover tower also was taken each hour during the study and the average SO<sub>2</sub> in the gas at each test point was related by the percentage conversion formula to the average SO<sub>2</sub> in the entrance gas during the same period.

EXTRACTS from the data obtained, given in Table VII, are of particular interest here. The figures for conversion, of course, include in each case acid made in the Glover tower. Excluding acid so made, the actual rate of production in the 51.9 per cent of chamber surface was 0.927 sq.ft. per pound of sulphur. It might be noted, however, that previous figures given for rate of production in various types of equipment include acid made in the Glover tower, so that the figure of 0.683 sq.ft. per pound of sulphur is comparable to those figures.

At the point representing 51.9 per cent of chamber surface, SO<sub>2</sub> content in the gas had been reduced to about 2.75 per cent by volume and from this point on action was much less rapid, averaging 2.13 sq.ft. per pound of sulphur.

A consideration of the principles involved seems to indicate that this latter part of the system is the stage in the process at which the use of the Schmiedel box or the flue system is indicated and were I building a chamber set I should proceed upon that assumption.

I should have in my chamber set, then, the following elements:

1. A Glover tower of ample size, and preferably of acid-proof masonry construction, in order that the greatest possible use might be made of available heat.
2. (A), Chambers varying in number with the size of the plant, but with sufficient area to handle from 60 per cent to 75 per cent of the total desired production, the calculation of surface needed being based upon about 0.65 sq.ft. of surface per pound of sulphur for 60 per cent of the production or 0.70 sq.ft. for 75 per cent of the production, or—(B), A Pratt chamber and converter tower of sufficient size to handle 60 per cent to 75 per cent of the production, the calculation in this case being based upon 0.60 sq.ft. and 0.65 sq.ft., respectively.
3. Schmiedel boxes or flue banks and towers to take care of the remainder of the production.
4. At least two Gay-Lussac towers of ample size.

With such a system, one would have sufficient gas reservoir in the chambers to avoid bewilderingly rapid changes in chamber atmosphere, and at the same time would have intimate mixing of the reacting gases at the end of the system where the reaction tends to slow down. Such a chamber set should operate with stability and should cost less than the standard chamber set.



# Production Factors Reflected in Cost Trends

Ratios of wages, salaries, materials and power to the value of product show progress of chemical engineering industries since 1914

By E. T. Dunn and W. N. Watson

Chemical Division, U.-S. Tariff Commission,  
Washington, D. C.

STATISTICAL reports based upon reliable figures reflect the trend of industry. The apportionment of sales value to wages, salaries, and costs of material indicates the relative importance of these factors in production. Their relationship in industry determines, in part, location of plants. Knowledge of the relationship aids the executive in his comparison of individual plant efficiency with that of the industry as a whole and enables the investor better to discriminate among vital factors which, by fluctuation, may appreciably affect an industrial investment.

Relationship of wages, salaries, and costs of material to sales value and the ratio of value of products and horsepower to the number of wage earners are charted here for 24 chemical engineering industries. These calculations are based upon the Biennial Census of Manufactures and include the years 1914, 1925, and preliminary figures for 1927. This calculation brings to date

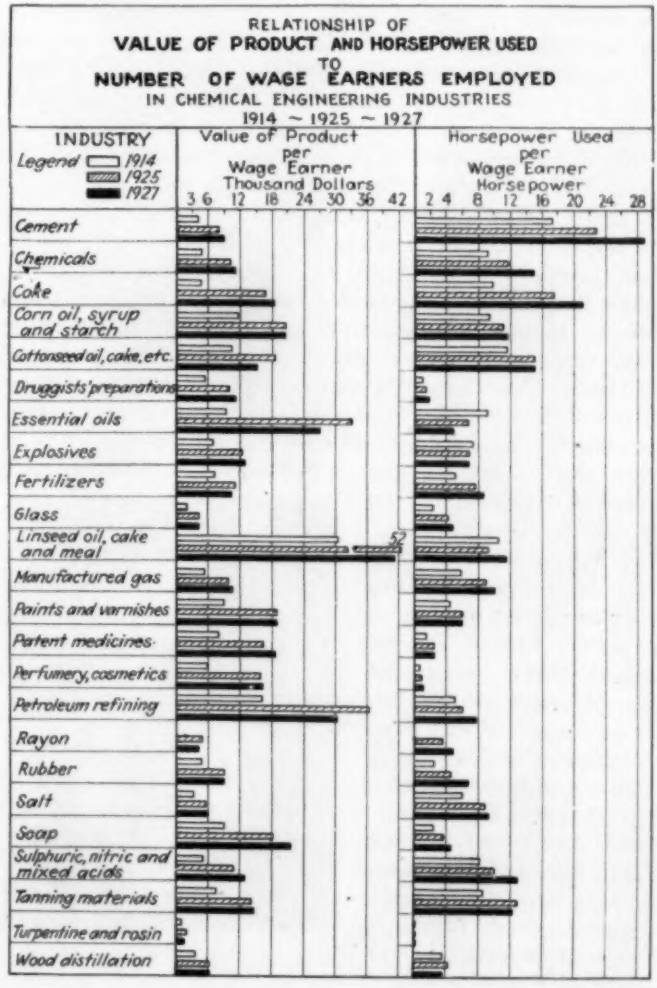
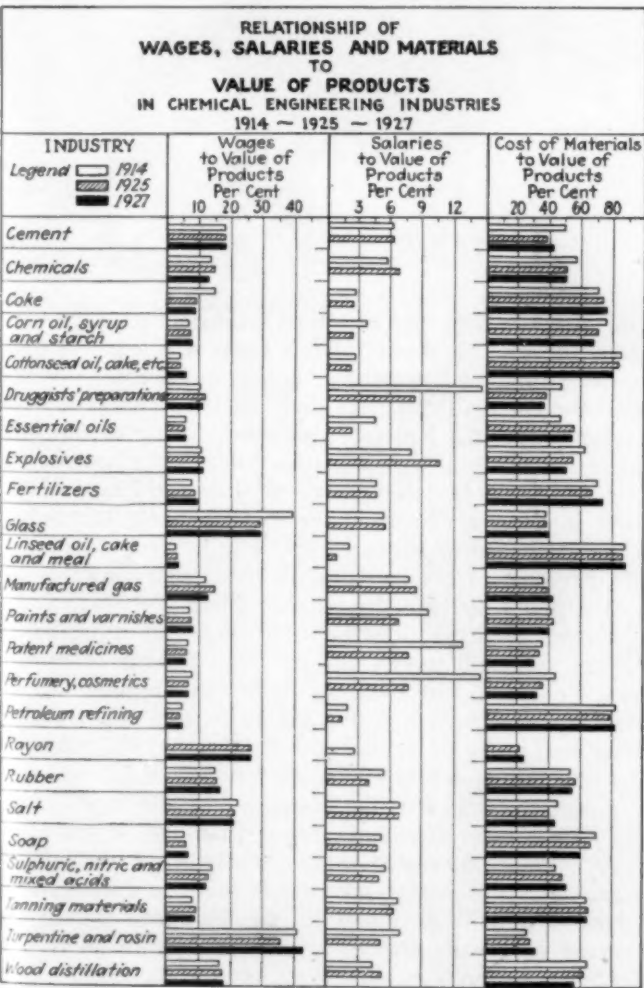
similar ratios for 1919, 1921, and 1923, as given in an article by C. R. DeLong, published in *Chem. & Met.*, December, 1925.

Material cost, in general, is the largest single item entering into the determination of value of products. In 1927, the linseed oil, cake and meal industry showed the largest material ratio, 87.6 per cent; the rayon industry, the smallest, 23.4 per cent. The wage ratios for these industries were, respectively, 3.9 per cent (lowest for the 24 tabulated) and 26.1 per cent (third highest). The maximum percentage in wages, 42.5, is credited to the turpentine and rosin industry.

In 1925, the latest year for which figures are available, there was a marked change from 1914 (5 per cent decrease) in the ratio of salaries to value of specialty products, such as druggists' preparations, patent medicines, perfumes, and cosmetics. The salary ratio was largest in the explosives industry, 10.7 per cent, and smallest in the linseed oil, cake and meal industry, 0.8 per cent.

The ratios of output and horsepower to the number of wage earners evidence progress in the use of automatically controlled process units. In 1927 the production ratio, 41 per cent, was highest in the linseed oil, cake and meal industry, and lowest in the turpentine and rosin industry, with 1.1 per cent. The ratio of horsepower to the number of wage earners in the tabulated industries ranged from 29.1 per cent in the cement industry to 0.1 per cent in the turpentine and rosin industry.

The wage, salary, and material ratios, graphically illustrated in the accompanying charts, emphasize the basic relationship of these factors in production to the value of sales in chemical engineering industries.



# Chemical Engineering's

## CONTRIBUTION to the



1879

AS WE look back over the history of the incandescent lamp we appreciate more and more that its conception and invention were due to the indefatigable experimenting and to the capacity for unceasing industry of Thomas A. Edison. The sincere interest and enthusiasm of W. R. Whitney, W. D. Coolidge, H. C. Rentschler, Irving Langmuir and others in contributing to the development have helped to make it one of the most potent influences throughout the world.

Mr. Edison first began his study of the incandescent lamp problem in the fall of 1877. He had a well equipped laboratory at Menlo Park, N. J., and on Oct. 21, 1879, he made an experimental lamp which embodied the basic features of all lamps made today. It consisted of a carbonized cotton thread operating in a very high vacuum maintained by a one-piece all-glass globe. This lamp burned for nearly 48 hours. There are many men who must be able to recall his announcement of the practical lamp in an article which took the entire first page of the *New York Herald* of Sunday, Dec. 21, 1879.

In 1904, Dr. Whitney, head of the research laboratory of the General Electric Company, at Schenectady, N. Y., had developed an electrical resistance furnace which enabled him to invent the Gem or metalized carbon filament lamp. It was operated at 25 per cent higher efficiency than the regular carbon lamp. The chief change in the physical properties of the Gem compared with the carbon filament lamp, which made it possible to operate safely at a higher temperature and so give it a greater efficiency, was the change in the treated coating of the filament.

In the first few years of the present century several men both in America and in Europe began investigating the use of metal for filament production. Carl von Welsbach, working in Europe, invented the first commercial metal-filament lamp, the osmium lamp, but it was used only in very limited quantities. Werner von Bolton, a Russian chemist, in the employ of the Siemens &



Marvin Pipkin Has Given Us the Inside Frosted Bulb



Conception and Invention of the Incandescent Lamp Were Due to Thomas A. Edison

Halske Company, the electrical manufacturers in Germany, developed, about 1905, a lamp which had a filament of the metal tantalum. It was much more efficient than the carbon lamp. As early as 1893, Alexander de Lodyguine, also a Russian, suggested the use of tungsten and other materials to make up a composite filament.

About ten years later Alexander Just and Franz Hanaman, in Vienna, conceived the idea of trying to produce a tungsten-filament lamp. Their efforts were directed in the direction of producing a pure tungsten filament, but by the time they had succeeded in doing it their financial resources were so depleted that they had difficulty in raising sufficient money to apply for patents to protect their invention. In 1905, an American company bought Just and Hanaman's patent rights in this country and, after two years of further development work, marketed the first tungsten-filament street lamps.

About the time that the tungsten filament was attracting world-wide attention, Doctor Coolidge, at Schenectady, became interested in the problem of producing a ductile tungsten and began his brilliant investigation in which he ductilized a non-ductile metal and greatly increased its tensile strength. His success in producing ductile tungsten was announced in March, 1910. Four



# INCANDESCENT LAMP

years later, he was awarded the Rumford medal by the American Academy of Arts and Sciences for his scientific conquest.

It was about this time that Aladar Pacz announced his development of the "non-sag" drawn tungsten filament. In the gas-filled lamp it is most important that the coiled wire should not sag materially.

A detailed description of a method for the production of tungstic oxide for the drawn tungsten filament was given by W. B. Gero and C. V.



W. R. Whitney Invented the Gem Lamp



H. C. Rentschler Developed the Method of Preparation and Heat Treatment of Thorium for Filaments

Iredell, of the Westinghouse Lamp Company, in *Chem. & Met.*, vol. 35, No. 7, pages 412-417 (1928).

The early inventors of "getters" included John Waring, who used bromine for reducing the discolorization on the inner surface of his Noval lamps. John T. Marshall, about the same time, invented the present-day method of exhausting tungsten-filament lamps without lighting the filament. Franz Shaupy, an Austrian chemist, later developed the use of getters in metal filament lamps to lessen the blackening of the bulb caused by the deposit of the filament material. Finla proposed the use of potassium iodide mixed with water, and in 1912 this getter was used in the smaller sizes of lamps. In the same year, Harry H. Needham applied for a patent covering the method of application and use of a double halogen salt, such as cryolite. Ernst Friederich, a German, invented a getter consisting of barium chlorate, manganese dioxide and red phosphorus. And in June,



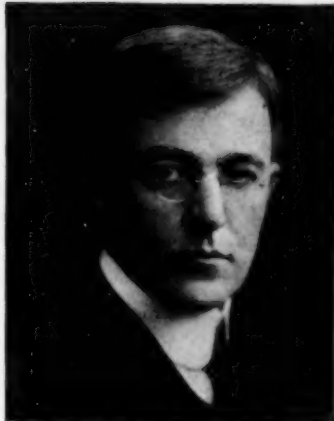
1929

1915, Frederic W. Gill applied for a patent covering a getter which could be applied directly to the filament.

Meanwhile at Schenectady, Doctor Langmuir was investigating the causes of the blackening of the bulb and after untiring efforts and many discouraging tests he found that the blackening of the well-made tungsten lamps is caused by true evaporation of the filament. He also found that the presence of a chemically inert gas inside the bulb would reduce the rate of evaporation of the filament. Argon mixed with about 15 per cent of nitrogen proved to be the most satisfactory combination of gases, not only to repress evaporation of the tungsten filament but because of its lower heat conductivity, with less cooling of the filament.

Platinum was used for leading-in wires from the very earliest days of the lamp until Byron E. Eldred developed a substitute wire which he patented in 1911. Shortly afterward Colin G. Fink invented an improved wire which was put into commercial use in 1913, superseding Eldred's wire. This wire is even better than platinum and is known as "dumet" wire.

Among recent developments in the incandescent lamp are the preparation and heat-



Development of the Gas-Filled Lamp Is Due to Irving Langmuir



Dumet Wire Is One of Colin G. Fink's Contributions to the Incandescent Lamp

treatment of thorium by J. W. Marden and H. C. Rentschler, of the Westinghouse Lamp Company. Marvin Pipkin, of the General Electric Company, has contributed to the efficiency and strength of the frosted lamp by developing a process for etching the inner surface of the bulb. The details of the method were described in *Chem. & Met.*, vol. 34, No. 11, page 660 (1927). The announcement by A. F. Lindstrom, of the Westinghouse company, of his invention of a commercial process for inside coloring is made on the following page.

# Coloring Incandescent Lamps on the Inner Surface

By *A. F. Lindstrom*

*Westinghouse Lamp Company  
Bloomfield, N. J.*

**C**OLORED incandescent lamps were first introduced to the public at the time that the old "tip" bulb was in vogue. The bulbs were dipped into colored lacquers and the excess liquid drained off the tips of the bulbs. The bulbs were efficiently and evenly colored by this method, but the lacquers tended to peel and chip, due to chemical changes such as were induced by the heat of the lamp or exposure to weathering when the bulbs were used for outdoor display-sign advertising. And with so many concerns using electrical display signs to advertise their various commodities; so many public affairs conducted in the open air under varicolored incandescent lamps, and with such a demand from housewives for colored lamps that would withstand changes in temperature, it was soon realized that something must be done to produce a permanent coloring for the bulbs.

With these objections to the present method in view the chemical engineers of the Westinghouse Lamp Company determined to develop a process that would give the lamps a permanent colored finish. It is the purpose of this paper to describe the process of "inside coloring" of the bulb which was the result of this investigation. While the investigation was in progress an evolution of the incandescent lamp bulb was taking place. The old tip was eliminated and the "sealing" of the bulb to retain the vacuum was done at the base instead of at the tip.

The problem of producing a method for making a more permanent coloring consisted of finding a coloring material immune to temperature and weather changes, and a process of application that would be more satisfactory than the "dipping" process in use. A material was eventually produced that was superior in every way to the lacquer formerly used. Then a system of spraying this liquid onto the outside of lamp bulbs was introduced. Though this spray process was much more involved than the old method of dipping the bulb, and required close chemical control, it was felt that the

superior qualities of the coating material used justified the additional work required.

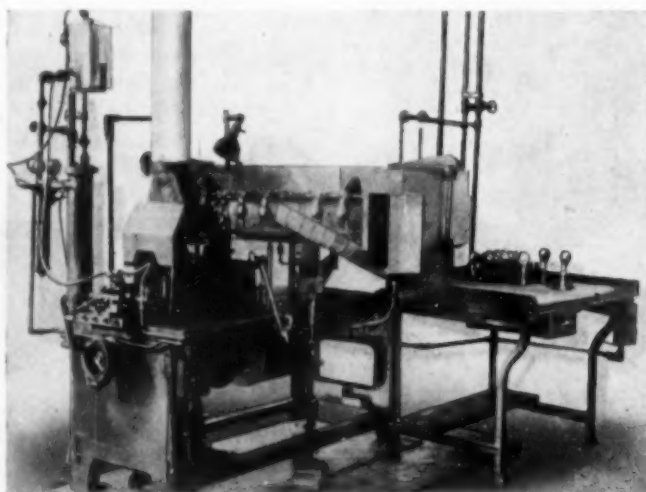
It was soon found, however, that the new coloring fluid, consisting of water, inorganic pigments and an inorganic binder, could not be sprayed onto a gas-filled lamp due to its increased heat resistance without danger of deterioration by the higher temperature involved. Generally speaking, this coating when properly applied to a lamp is permanent if the lamp is burned without

exposure to weathering, but it was soon found that if the lamp was exposed to outdoor conditions it gradually peeled and faded.

It was then realized that the only means of producing a permanent coloring would be by applying the colored finish onto the inside of the bulb, where it would not be affected by the weather. This, in turn, presented its problems. Obviously, a bulb could not be filled with the coloring liquid and drained as had been done when the coloring was on the outside of the lamp. This method would be unsatisfactory, cumbersome and wasteful of time; a sprayer would have to be employed, which would distribute the liquid evenly over the inner surface of the bulbs.

The inorganic liquid used for coating the outside of the bulb was not of the proper consistence to use in a spray gun with satisfactory results. It was then evident that a suitable spray must be developed in order to use the heat-resisting permanent coloring material previously found to be satisfactory. It also was necessary to develop a machine with almost human intelligence to operate the spray gun.

A fan-shaped spray gun was developed in order that the liquid would flow evenly, but it was found that in order to obtain the desired results in distributing the coloring fluid on the inner surface of the bulbs it was necessary to work as close as 0.001 in. This necessitated a machine so timed and adjusted that this could be expeditiously done. This spray gun and automatic machine for producing beautifully and permanently inside colored



Machine That Colors Incandescent Bulbs  
on the Inside



electric light bulbs are shown in the accompanying figure.

The clear bulbs are loaded onto a reel provided with suitable metal jaws which grip and pass the bulbs through an oven for heating to the proper temperature. Immediately upon leaving the oven the hot bulb is moved to a position in front of the spray gun with the open base fronting the gun, where a transfer arm grips and rotates it at a speed of 700 r.p.m. While in this horizontal position the gun is moved into and out of the bulb automatically by a specially designed cam. An additional co-ordinated cam operates the paint valve on the gun, which has been properly timed to release and shut off the paint. Since the neck will be "sealed" off later, it is not necessary to coat the entire inner surface of the bulb, but only to the neck. Where the paint-coating ceases in the neck of the bulb will be the exact point on the neck where the base will reach after being put on, thus leaving no clear unpainted portion showing on the inside of the bulb when finished.

**T**WO complete passes of the gun, in and out of the bulb, are sufficient to deposit the required amount of coating. Upon completion of the second stroke of the gun, the cam withdraws it and the transfer arm passes the coated bulb back to the reel. At the next index of the machine, the metal gripping jaws automatically open and the bulb drops down a chute onto an inspection table, where it is checked for color-density standards and possible coating defects. This is done by placing the bulb over a specially designed test lamp.

Unlike the outside spray coating process, which also is used on certain lamps that will not be exposed to weathering, this inside coating method is based entirely

upon keeping the bulb dry. It is for this reason that the bulbs are heated. In addition to having the bulb hot to begin with, an auxiliary spray plays on the bulb while in the spray position. This is done to compensate for the loss of heat from the bulb while in the process of being sprayed.

The air pressure used to atomize the spray varies somewhat according to the color being used, but in most cases it is between 20 and 40 lb. per square inch. Having colored the bulbs, they are handled by the lamp machine in a manner similar to the way clear bulbs are handled.

The inside colored electric light globe has contributed something to the lamp industry that is a real boon to all who have any occasion to use colored lamps. Particularly does this apply to those who make or who use colored electric signs, whether indoors or outdoors, or those who wish decorative effects in homes or elsewhere. The inside application of this permanent coloring material leaves the outside of the lamp exactly as it was before. The color cannot be chipped off or scratched off and weather cannot affect it. If the outside of the globe becomes stained or dirty, it can be expeditiously cleaned and the outside surface of the lamp again has all its pristine gloss and attractiveness.

Not only is the inside colored lamp a distinct advance over the old-style, outside-sprayed globe in that its decorative and sign display value is so much greater but also because those in the home or the office who wish a softer, filtered light to work under will get much better results from this lamp than from the old style and at no greater cost. In short, the inside colored lamp is the answer to the demand for a lamp that is permanently colored, immune to weather, easy to clean and decorative.

## New Phosphate Technology in the Making

Fertilizer association papers  
show economic trends and  
recent technical achievements

### *Editorial Staff Report*

**F**IVE papers on phosphates presented at the recent annual meeting of the National Fertilizer Association picture the present status and the important trends in the economic and technical developments of phosphatic fertilizer making in the United States.

The first of these papers, by John T. Burroughs, vice-president of the International Agricultural Corporation, summarized the methods used in the Florida and Tennessee phosphate fields, where modern mechanical methods have radically changed the procedure for handling the raw rock. Formerly 5 cu.yd. of earth was moved per ton of finished product, but today 15 to 20 cu.yd. must be handled. This increasing burden of material handling has been met by introducing heavy hydraulic mining equipment, railroad-type steam shovels, and conveyors and cars of largely increased capacity and efficiency. As a result the cost per ton of phosphate rock prepared is little, if any, more than in pre-war days,

despite higher wages and greater quantities of material handled.

Rock washers formerly handled from 10 to 15 tons per hour, but steel units, of lower repair cost though requiring higher initial investment, now secure high recoveries at low total cost. In this part of the industry the phosphate business has borrowed freely from the metallurgical ore-dressing field and has obtained "new and startling improvements" by which even the colloidal slimes are saved. The first flotation plant used in the industry is now apparently demonstrating its success and promises great advantages. If as successful as expected, this process will double the available land area from which phosphate may be recovered, giving a purer product and "results even more spectacular than any yet seen."

Since capital charges have now become so important a part in phosphate costs, it has become desirable to operate with a load factor as near as possible to 100 per cent. The question of preparing a thoroughly dried product after washing and reclaiming of phosphate also is a serious question still partly unsettled. The evaporation of large tonnages of water to reduce phosphates from 15 or 18 per cent to a final 1 per cent moisture content demands use of the most modern driers of high thermal efficiency and low labor cost. And also it is suggested that "a little well-directed thought may find a way to avoid the evaporation of all this moisture and thereby effect a most important reduction in the use of fuel."

Western methods of phosphate handling, which are in striking contrast with those of the South, were described by E. L. Larison, superintendent of the

phosphate plant of the Anaconda Copper Mining Company. These Montana operations involve stope mining for recovery of phosphate rock from the 9-ft. beds which lie at a steep angle in most of the deposits of that territory. This rock is obtained quite free from wall material and contains about 32 per cent of  $P_2O_5$  and about 4 to 6 per cent moisture. Approximately 0.94 ton of dry rock is obtained from each ton of material removed from the mine, a recovery in striking contrast with the low percentage yield in the South.

The only way in which these distant phosphates can reach important consuming centers is as a highly concentrated product. The Western technique requires the making of a moderate-strength phosphoric acid by treating a ton of rock with 1.25 tons of 50 deg. sulphuric acid. Reaction between this phosphoric acid and additional rock gives a product containing approximately 45 per cent of  $P_2O_5$  with a final recovery in this "triple superphosphate" of 85 per cent of the  $P_2O_5$  in the original rock. This product contains its phosphate in a form chemically almost identical with that of ordinary grades of superphosphate, namely as monocalcium phosphate. In this concentration it is economically possible to reach the agricultural areas with Western phosphates.

An example of some of the cost factors involved is given by this engineer in contrasting 3-9-3 with 9-27-9 fertilizer, the former made from ordinary superphosphate and the latter from the triple grade. "The  $P_2O_5$  in 3-9-3 can be obtained from 17 per cent acid phosphate at, let us say, 65c. while that in the 9-27-9 will cost, say, 85c. The difference for 27 units at 20c. per unit is \$5.40. The cost of bagging at \$3 and freight at \$3.50 amounts to \$19.50 for three tons of 3-9-3, and to \$6.50 for 9-27-9, a difference of \$13 in favor of the latter or, deducting the \$5.50 expended for the concentrated superphosphate, a saving of \$7.60 on the higher analysis."

**E**CONOMIC competition of other phosphate materials with superphosphate is forecast by K. D. Jacob, of the Department of Agriculture, who discussed the new chemical and economic factors affecting this business. He pointed out that already five double superphosphate plants are operating in the United States and shortly another large plant of this character is to be built at Tampa, Fla., by the American Cyanamid Company. Furnace processes for making liquid phosphoric acid also are beginning to play a significant part and are likely to become important in the domestic fertilizer industry of the South. In the United States only a negligible percentage of the phosphoric acid so made now enters the fertilizer business; but the European situation is different, since much furnace-made acid is already used by the fertilizer industry on the Continent.

Although not yet competing in producing cost per unit of plant food contained, concentrated phosphates can be handled and hauled on such an economical basis that they already promise important advantages from the standpoint of the ultimate user. It is particularly important to notice that the preparation of balanced mixtures containing 25 per cent or more of total plant food requires some of these high-concentration phosphates. Chemical salts such as ammonium phosphate are important to boost the  $P_2O_5$  content in such cases, even though the base supply may be a normal grade of superphosphate.

Ammoniated superphosphate has been proved during the past year to be a new and very important constituent of commercial mixtures. This is made by treating superphosphate with just enough ammonia liquor to produce

the right degree of acidity. This procedure is of advantage because ammonia as liquor costs less than as ammonium sulphate and, moreover, has an advantage in producing a better mechanical condition in the mixes to which it is applied.

Improvements in sulphuric-acid making have had a considerable influence in cheapening fertilizer costs recently. The use of ammonia oxidation instead of niter pots to supply the nitrogen oxide for chambers has resulted in more uniform and efficient functioning. The use of vanadium catalysts in the contact process also has contributed greatly to lower cost contact-process acid, which is suggestive of important possibilities for plant betterment in the fertilizing industry also. In connection with these comments by Jacob, it is of interest to note also the interpretation given by Larison to proper cost-keeping methods in the Western phosphate business where some have assumed that the sulphuric acid, which is a byproduct of ore smelting, should be charged against the metallurgical departments instead of to the fertilizer business. Larimore indicates that such plan is not practicable, but that the making of the acid must be charged against the fertilizer just as is the case in the Southern superphosphate business.

**S**ELLING of superphosphates demands industrial propaganda, according to James J. Collins, who described to the conference the plans and the work of the new Superphosphate Institute of which he is executive secretary. He expressed the opinion that not only for trade promotion but also for co-operation in statistical work and economic handling of the business within the United States, there must be full co-operation of the membership of the industry through the Institute.

World trade development in the phosphate-rock business has shown surprising growth of the industry during recent years, according to the summary presented by Morgan H. Grace, president of the Phosphate Export Association. In his opinion there has been not only the well recognized increase in tonnage used but also a simultaneous increase in the concentration of phosphate in the materials handled, amounting to a 10 per cent increase in concentration in Europe and about a 4 per cent increase in the United States. In connection with phosphate-rock developments, however, one must consider also the consumption of basic slag, especially in Europe, where about 4,300,000 tons per year of this material is now used. For a further expansion of phosphate markets Mr. Grace emphasizes the necessity of additional experimental work in agronomy.

Nationalism, which has been greatly accentuated by the World War, creates a serious obstacle to free movement of phosphates in world trade just as it has created unusual problems in the nitrogen business. Apparently European countries are going to insist upon development of phosphates in their own colonial territory, especially in North Africa, in so far as it is possible. Various governments are actually entering into the phosphate business to a greater or less extent, as described by Mr. Grace, including France in Morocco, Great Britain in New Zealand and other South Pacific possessions, Japan through the development of the Anguar deposits, and to some extent other nations. All of this is at times discouraging to the normal movement which would otherwise take place under the pressure of economic conditions; and it makes even more necessary, according to Mr. Grace, the co-operation of the American phosphate business for which the Superphosphate Institute stands.



# Viscous Liquid Mixed and Dried in 80 Per Cent Less Time

By R. D. Jessup

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Western Electric Company, Chicago, Ill.

**M**IXING and drying of a very viscous rosin insulating compound in one-fifth of the time formerly required, using greatly reduced floor space and equipment but maintaining at the same time good quality of product, is one of the recent accomplishments of the development engineers at the Hawthorne plant of the Western Electric Company. This development became necessary almost as an emergency measure due to the heavy increase in loading coils where most of this compound is used.

The old process was quite simple. Lump rosin, together with the right proportion of rosin oil, was loaded into an upright cylindrical tank supplied with internal steam-heating coils. The mixture was raised to 240 deg. F. and maintained at this point for 24 to 36 hours, depending upon the amount of moisture present. From eight to twelve hours was required to melt the rosin and the remainder of the time to boil out the moisture to a point where the insulating qualities of the compound were satisfactory. Four tanks were in use and were operating to capacity. Floor space for expansion was very limited.

The problem then was to get increased output without increasing the equipment. The two main features of the solution of this problem were the use of circulation

of the liquid part of the compound in order to melt the rosin rapidly, and the continued circulation, together with application of vacuum, to remove moisture as quickly as possible.

The arrangement of equipment is shown diagrammatically in Fig. 1. Fortunately, tanks Nos. 1 and 2 were designed sufficiently heavy to withstand vacuum and a vacuum cover was ordered for each. The cover for No. 1 tank is provided with a door through which lump rosin is loaded. All of the pipe through which the compound circulates excepting the overflow connection between the two tanks is steam heated. This is very simply accomplished by running a small steam pipe adjacent to the compound pipe and covering both by a single pipe covering. Valves are not heated and covered, as they receive sufficient heat by conduction.

A blow case was chosen as the most convenient means of moving the compound and was improvised from a cylindrical cast-iron loading coil case. The blow case holds about a barrel of compound which has the most convenient equipment available. Operation of the compound and air valves is accomplished by means of a solenoid operated by a contactor, which in turn is operated by a float in the blow case. It is, of course, unsafe as well as undesirable to have an electric

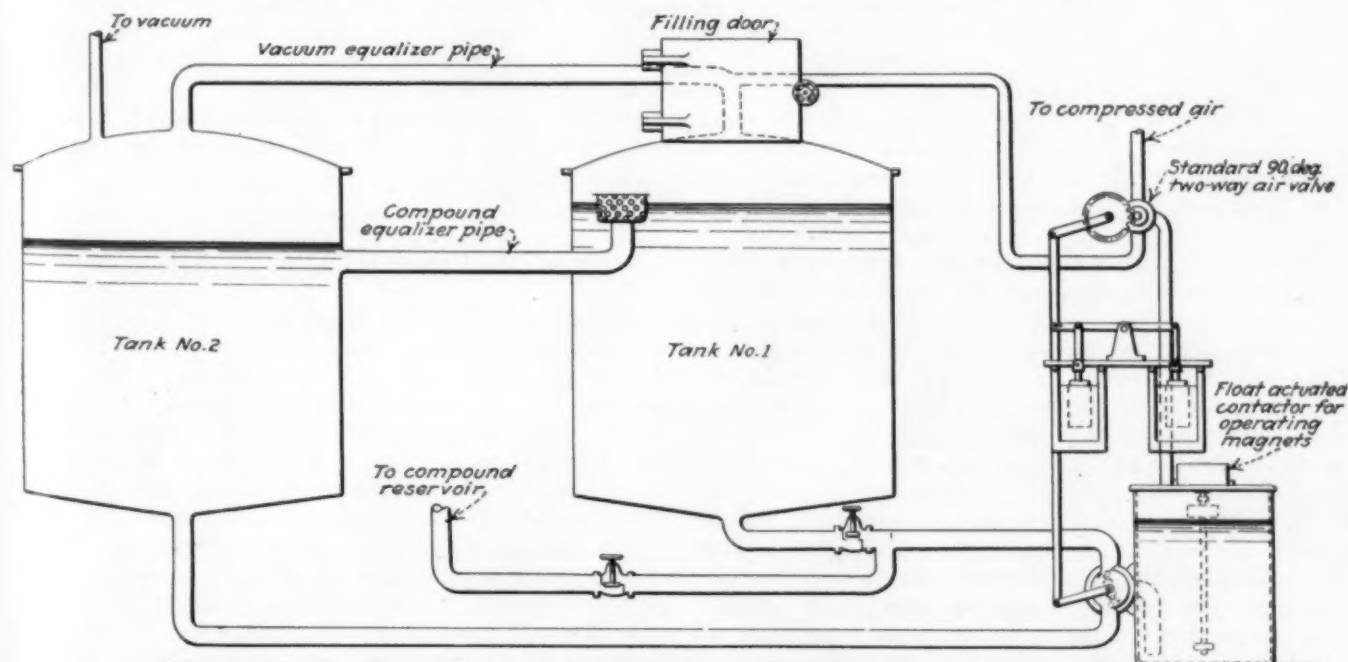


Fig. 1—Operation of the Solenoid and the Blow Case in Circulating the Liquid in the System

contact operating within the case itself. The answer to this problem was found already worked out and on the market. In order to transmit the pressure of the float rod to an external contactor without encountering this objection a "Mercoid Combination Control" manufactured by the American Radiator Company was adopted.

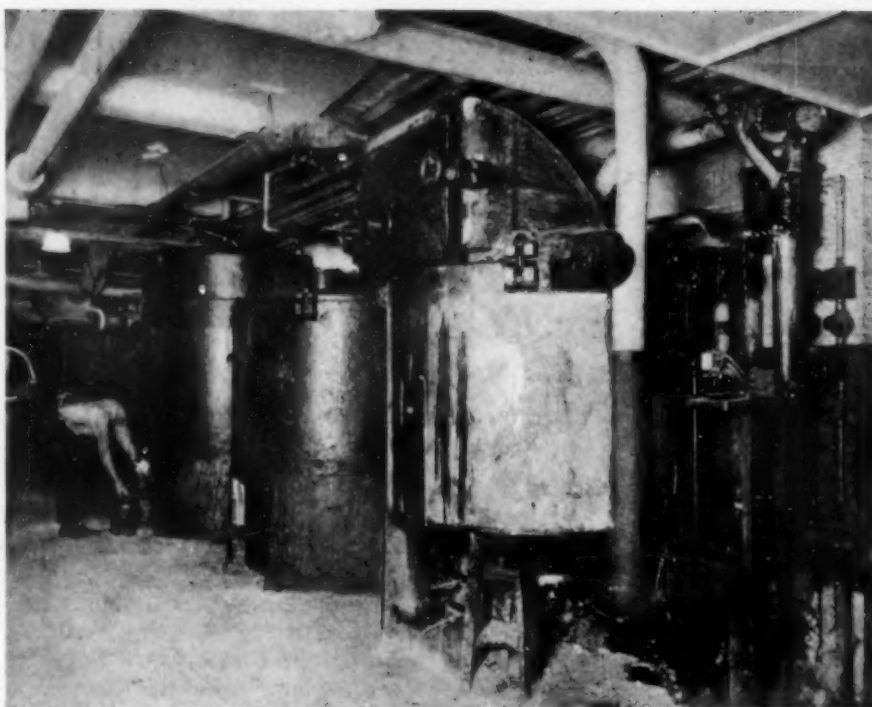
A slight amount of alteration was necessary in connecting this apparatus to the float rod. It will be seen from Fig. 2 that the pressure of the float lever is transmitted to the external contactor through a sylphon bellows. The cycle of operations of this apparatus requires about one minute. Steam coils surround the blow case and both blow case and tanks are covered with 2 in. of rock wool heat insulation.

The operation of the equipment is as follows:

Finished compound in tank No. 2 is transferred to a reservoir tank. The loading door in tank No. 1 is opened and lump rosin is shoveled into it. The tank holds about eight barrels of lump rosin and as the loading proceeds the greater part of the liquid in tank No. 1 overflows into No. 2. The correct quantity of rosin oil as determined by the weight of rosin placed in tank No. 1 is then added. It is pumped in through a meter, the quantity being thus regulated.

At this point of the process it will be seen that there is a little less than ten barrels of an undetermined mixture in each of the two tanks, No. 1 containing mostly solid rosin and No. 2 having more than the right proportion of rosin oil. The circulating system operates to equalize this condition. Liquid flows from tank No. 2 into the blow case until the float rises to the top. This reverses the contactor and causes the solenoid to reverse the positions of the compound and air valves. This connects the blow case with tank No. 1 and at the same time introduces air pressure in the top of the blow case, forcing its contents into tank No. 1. Hot compound is thus brought into contact with the lump rosin and the whole charge usually is melted in two or three hours. During the melting period the vacuum is not applied. As soon as the rosin is melted and the mixture has reached the required temperature of 240 deg. F., however, about 5 in. of vacuum is applied to the system. This causes a more rapid evaporation of moisture as indicated by very active foaming of the compound.

The condition of the charge can be watched through an observation window in the cover of the tank. The



**Fig. 2—Equipment in Hawthorne Plant of Western Electric Company for Melting, Mixing and Drying Rosin Compounds More Rapidly by Circulation**  
Tanks Nos. 4 and 3, on the left-hand end, serve for storing the finished material. Nos. 2 and 1 are used for melting the compound. The blow case can be seen on the extreme right.

Fig. 2 shows the installation as it now appears. Tanks Nos. 3 and 4, shown on the left in Fig. 2, are used for storage purposes. In order to obtain sufficient storage capacity it was necessary to increase the height of No. 3 by adding a section which is clamped to the tank proper, using a gasket.

This installation assumed its present form largely due to the fact that certain equipment was available to start with. Its ultimate capacity has now been reached and further expansion is making necessary the provision of additional equipment. This has been designed along somewhat different lines although the fundamental principles of using circulation and vacuum are retained.

It is believed that this process for melting and drying rosin, a poor conductor of heat and a very viscous and dense liquid at the temperatures at which it may be heated, will find application in other of the chemical engineering industries.

## New Heat-Resistant Alloy

The development of a metal alloy that would repeatedly withstand working temperatures in excess of 2,000 deg. F., in contact with molten metal, was recently announced by Alexander Forward, managing director of the American Gas Association. Formerly crucibles had a life of only about 15 or 20 heats, but a single retort made from the alloy produced has already served for more than 250 heats and is none the worse for wear.

The research work in connection with this new ferrochrome alloy is only partially completed and it is expected that another year will be required to develop an alloy that will meet all of the requirements of the brass furnace. This investigation is being conducted on contract between the American Gas Association and the American Gas Furnace Company, of Elizabeth, N. J.

amount of vacuum is gradually increased up to 20 in., during which time circulation is continued. Tests of the compound indicate that five or six hours of this treatment gives results equal to those obtained by the old boiling process in 24 to 36 hours. When the process is completed the valve to the compound reservoir is opened, the valve to tank No. 1 is closed and the compound in tank No. 2 is pumped into the reservoir by means of the blow case. The system is then ready for a new load.



# How Industry Absorbs College Crop of Chemical Engineers

By James A. Lee

Assistant Editor, *Chem. & Met.*

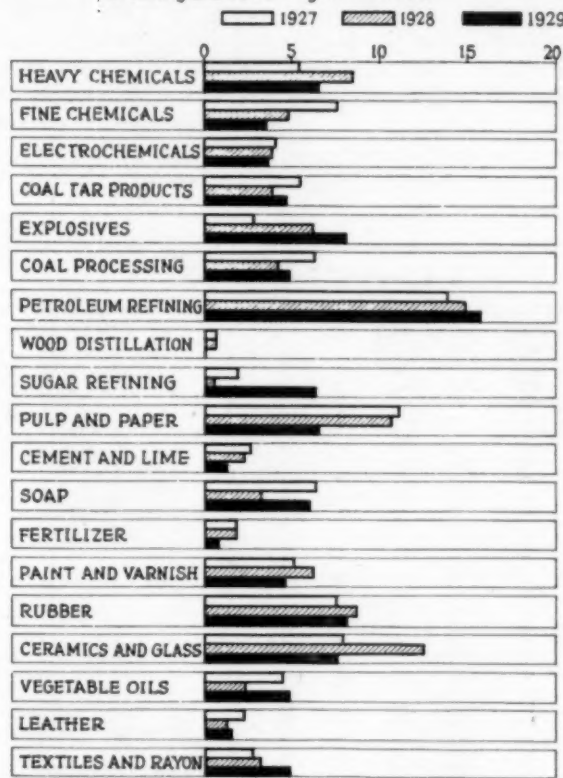
**R**EGISTRATION in chemical engineering in our universities and colleges increased by more than 20 per cent last year. Sixty of the 80 institutions that give courses in chemical engineering reported a current output of 740 graduates. Of the number that went directly into industry the figures show that one in every six went into petroleum refining while only one in fifteen was absorbed by the strictly chemical industries. These and other interesting deductions and trends are revealed as the result of an extensive survey that *Chem. & Met.* has conducted through the cordial and effective co-operation of the chemical engineering departments of the principal colleges and universities of the United States.

Questionnaires were sent to about 80 institutions that were known to offer courses in chemical engineering and that participated in a somewhat similar survey in 1922 made by the committee on chemical engineering education of the American Institute of Chemical Engineers. The data requested covered the distribution of the graduates among nineteen process industries, the number of undergraduates and post graduates, the size of the graduating classes and the total number of students registered in the departments. Figures were requested for 1926-27, 1927-28 and 1928-29. Although responses to the questionnaire were received from 60 institutions only 45 reported data for all three sessions, while some replies were only partially complete and a few stated that authoritative and comprehensive information was not available.

The distribution in the process industries of the chemical engineering graduates of the classes of 1927, 1928 and 1929, based on only the replies containing complete

## DISTRIBUTION OF CHEMICAL ENGINEERING GRADUATES

Percentage of Chemical Engineering Graduates Entering the Following Industries



Figures not available on number of students going into sugar industry from Louisiana State University in 1927 and 1928

data, is shown in the accompanying chart. The percentages for the first year are based on 315 graduates from 45 institutions, for the second year on 310 and for the third year on 360. While these figures are based on only about 50 per cent of the total number of graduates from all of the institutions, it is doubtful if the percentages would be materially different if the entire number were considered. For example, the figures for the Massachusetts Institute of Technology, which were received too late for the preceding compilation, show the following distribution for the 1928-29 class of 49 chemical engineers: Petroleum refining, 16; explosives, 4; heavy chemicals and rubber, 2 each; electrochemicals, coal-tar products, pulp and paper, paint and varnish, and leather, 1 each; industries not listed in the chart, 7; and graduate work, 13.

The industries have been arranged in order of relative penetration of chemical engineering in the dif-

ferent fields according to *Chem. & Met.*'s estimate (see page 5, January, 1928). When examining the figures in this tabulation the relative and possible penetration also should be considered. In the strictly chemical industries where there is complete recognition of chemical engineering, there is continued demand for young graduates in this branch of engineering, with only one exception: The figures indicate a slackening in the demand for engineers in the fine chemical field.

The petroleum refining industry, according to the tabulation, has attracted twice as many 1929 graduates as has any other individual industry. It apparently is moving with a constantly increasing acceleration toward a scientific basis and absorbing more and more chemical engineers. Indications are that petroleum will be even

more of a chemical engineering industry in the future.

The rubber industry is one of the group of industries in which there is a predominance of mechanical and electrical rather than of process operations and so limits the extent to which chemical engineering may be a production factor. However, in January, 1928, it was estimated that only about 65 per cent of the possible penetration of chemical engineering in this field had occurred, but there is increasing evidence, such as is indicated in this tabulation, that appreciation of the chemical engineer by the rubber industry is becoming more pronounced. Webster H. Jones, general superintendent, processing division of the B. F. Goodrich Company, made the statement at the recent chemical engineering education symposium, that in recent years his company has been employing proportionately more chemical engineers than chemists. This, he said, was because the engineer was more flexible and offered greater adaptability to the problems of the rubber industry.

So far there have been considered merely the industries that chemical engineering graduates have become associated with on leaving college. It is of interest, however, to observe the nature of the occupations of the men ten years after graduation. For this purpose the statistics of the chemical engineering classes of 1919 and 1920 of four typical institutions have been compiled and may be summarized as in Table I.

A consideration of the facts presented show that at least 65 per cent of the men graduated about ten years

Table I—Occupations of Men Ten Years After Graduation

	Per Cent
Chemical engineers and industrial chemists.....	43.7
Research chemists .....	9.2
Teachers of chemistry.....	8.4
Chemical salesmen.....	3.7
Industrial work, non-chemical.....	4.4
Non-industrial, non-chemical .....	13.3
No occupational record available.....	17.3
	100.00

ago from these institutions are using their technical knowledge in their present occupations.

On Nov. 1, 1927, according the U. S. Department of the Interior, Bureau of Education (*Jour. of Eng. Education*, Vol. XVIII, No. 10, p. 952, 1928), 5,987 students were enrolled in the chemical engineering courses of the 148 engineering schools of the country. In the list of approximately 30 engineering courses, chemical engineering ranked fourth in numbers registered.

There has been a remarkable increase in the total registration during the past two years, and the numbers that have remained to take graduate work are unusually large in some schools. Prof. Charles A. Mann, chief of the division of chemical engineering, University of Minnesota, states that over 65 per cent of his students remain in school to do graduate work.

Authoritative data on the number of undergraduates, of those graduating, of post graduates, and the total number of students are recorded in an accompanying

table. These data were reported for the past three years by 55 of the 60 institutions replying to the questionnaire. The schools were not able to furnish complete information in every case. In many instances no distinction was made between freshmen chemists and freshmen chemical engineers, and in several cases the undergraduate and total enrollments are misleading because many of the upper classmen received their first two years' training at a junior college. The growth of the junior colleges is having a noticeable effect upon the registration of the larger institutions.

When considering the data in Table II it is important to keep in mind that no attempt has been made to differentiate between quality and quantity of graduates, and that the latter is not necessarily a criterion of the former.

Table II—Chemical Engineering Registration Statistics for 55 of the Institutions Giving Courses in Chemical Engineering

	Undergraduates <sup>a</sup>			Graduating Class		Post Graduates			Total Registered—		
	1927	1928	1929	1927	1928	1927	1928	1929	1927	1928	1929
Alabama, University of.....	44	57	73	8	9	13	2	3	46	60	76
Arkansas, University of.....	22	31	33	2	1	3	0	0	22	31	33
Armour Institute of Technology.....	78	79	96	16	8	15	a	a	78	79	96
Bucknell University.....	36	42	50	8	2	9	0	2	36	44	52
California Institute of Technology.....	a	a	a	8	9	8	2	2	a	a	a
Carnegie Institute of Technology.....	35	45	46	7	11	10	0	0	35	45	46
Case School of Applied Science.....	58	60	77	8	26	15	0	0	58	60	77
Cincinnati, University of.....	155	176	244	18	13	15	a	a	155	176	244
Colorado, University of.....	49	49	52	3	9	11	2	1	51	50	52
Columbia University.....	45	45	45	24	24	26	74	72	119	117	128
Cooper Union.....	a	a	52	a	a	9	0	0	a	a	52
Dayton, University of.....	17	17	23	6	4	7	a	a	17	17	23
Florida, University of.....	7b	12b	19b	1	2	2	2	2	9b	14b	21b
Georgia School of Technology.....	55	41	60	12	8	11	a	a	55	41	60
Idaho, University of.....	a	a	a	0	3	8	a	a	a	a	a
Illinois, University of.....	118	116	132	10	12	12	9	10	127	126	145
Iowa State College.....	112	132	193	17	20	28	9	14	121	146	205
Iowa, State University of.....	38	42	46	11	12	18	6	4	44	46	56
Lafayette College.....	27	23	28	3	4	4	0	0	27	23	28
Lehigh University.....	110	80	98	23	21	39	5	10	115	90	106
Louisiana State University.....	52	42	a	23	20	25	22	11	a	a	a
Maine, University of.....	a	a	a	9	7	18	2	2	a	a	a
Massachusetts Inst. of Technology.....	211	232	229	47	52	49	68	85	279	296	314
Michigan, University of.....	125b	125b	128b	40	54	45	30	40	155b	165b	170b
Minnesota, University of.....	125	159	206	12	16	30	16	17	141	176	221
Missouri, University of.....	a	a	45	6	9	10	0	0	a	a	45
Montana State College.....	55	68	82	7	7	7	a	a	55	68	82
New York, College of the City of.....	a	a	a	a	a	a	a	a	33	49	66
New York University.....	43	45	35	10	12	8	4	4	47	49	38
North Carolina, University of.....	6	22	27	0	0	1	0	0	6	22	27
North Dakota Agricultural College.....	a	a	a	1	1	1	a	a	a	a	a
Ohio State University.....	359	272	254	40	59	43	27	33	386	305	284
Oklahoma A. and M. College.....	40	44	49	4	4	7	0	1	40	45	50
Oregon State Agricultural College.....	107	110	115	13	15	20	0	0	107	110	119
Pennsylvania State College.....	62	71	86	10	14	10	0	2	62	73	89
Pennsylvania, University of.....	14c	23c	25c	6	9	13	a	a	14c	23c	25c
Pittsburgh, University of.....	26	31	45	5	6	8	3	6	29	34	51
Polytechnic Institute of Brooklyn.....	77	90	104	6	2	2	0	2	77	92	108
Purdue University.....	175	209	259	22	19	31	6	9	181	218	264
Rensselaer Polytechnic Institute.....	133	141	161	18	16	23	4	3	137	144	163
Rice Institute.....	10	12	11	1	3	2	a	a	10	12	11
Rose Polytechnic Institute.....	18	31	35	1	7	3	0	0	18	31	35
Swarthmore College.....	a	a	a	4	1	3	a	a	a	a	a
Syracuse University.....	15	23	39	12	10	12	a	a	15	23	39
Tennessee, University of.....	8	13	23	1	1	3	0	1	8	14	24
Texas A. and M. College.....	88	144	199	11	11	27	3	3	91	147	202
Texas, University of.....	74	73	93	4	7	11	4	6	78	79	102
Virginia Polytechnic Institute.....	43	51	73	8	11	7	1	0	44	51	75
Virginia, University of.....	19	21	22	6	2	3	0	0	19	21	22
Washington, State College of.....	41	47	51	5	8	5	0	0	41	47	51
Washington, University of.....	44	58	59	11	8	11	0	5	44	63	59
West Virginia University.....	41	48	51	8	5	7	3	2	44	50	54
Wisconsin, University of.....	121	104	115	17	19	16	7	6	128	110	124
Worcester Polytechnic Institute.....	59	62	79	11	5	7	2	1	61	63	84
Yale University.....	36	33	35	13	13	10	3	6	39	39	45
Total.....	3,233	3,451	4,100	577	622	741	316	341	3,504	3,780	4,541

<sup>a</sup>Figures for undergraduates include graduating class.

<sup>b</sup>Figures not available. <sup>c</sup>Freshmen not included. <sup>d</sup>Freshmen and sophomores not included.



# Why Do Industries Migrate?

This economic study of major geographic trends forms a logical basis for planning future location of branch plants and new industries in the chemical engineering field

*By Charles W. Cuno*

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Industrial Bureau of the Industrial Club of St. Louis, Mo.*

ECONOMISTS usually have been more concerned with the concentration of industries than with the less obvious but more important fact that industry is continually migrating and that this migration is due to the influence of certain definite factors of plant location. The remarkable growth of American industry in scarcely more than one hundred years is marked by the constant migration of industry from points of centralization to other favorable points. These in turn become less important. If certain factors are especially favorable, it often means the shifting of the preponderance of manufacture almost entirely to these new locations.

Changes of this character often are so rapid that a quarter of a century, or even a decade, may show a shift of from 10 to 30 per cent of the nation's production to new points of centralization accompanied by capital investment of many millions of dollars.

In this connection Chaplin Tyler, in his book, "Chemical Engineering Economics," writes as follows:

The localization of chemical engineering industries is an excellent example of economic forces that tend to reach a condition of equilibrium. The principal component forces are: (1) markets, (2) raw-material sources, (3) labor sources, (4) fuel and power sources, (5) transportation facilities. Stable equilibrium is reached only when the greatest possible differential between cost and selling price obtains. In a large and well developed country like the United States it is possible to illustrate fully the forces governing localization. . . . Density of population is a basic index of consuming power and hence of industrial localization; and other conditions being favorable, the industries should follow the people, geographically speaking. It may be more rational, however, for an industry to disregard large centers of population and, instead, to seek cheap raw materials, labor, fuels and power. Lastly, trans-

portation cost may be such an important factor that it overshadows all others.

In commenting on the position of chemical industry in the industrial structure of the United States, *Chem. & Met.* (Vol. 34, No. 1, 1927) says, editorially:

A decentralizing influence has been at work, particularly since the War, and many established centers of certain industries have felt the effect of an industrial migration brought on by excessive costs of transporting raw materials and manufactured products, competitive bidding for labor and other of the disadvantages of a congested industrial district. Manufacturing is taking on a national character and consequently the market for chemicals is broadening to cover practically the whole of the United States.

From a study of the migration of a number of industries, a second generalization also may be made, one which executives of big business are just beginning to realize.

That is, that increasing the capacity of a plant, ruthless competitive methods, and well organized sales forces are helpless in preventing the migration of industry. To meet this migration it becomes necessary to establish branch plants in these migration centers, or better, by industrial engineering research, to forestall this competition by determining the logical migration points of industry and entering the field before independent competition has already pre-empted it.

BYPRODUCT coke was first produced in the United States in 1893. By 1899, 1,020 byproduct ovens produced 906,544 tons of coke, less than 5 per cent of the nation's production. While coke was manufactured in the United States prior to 1840, it first appeared in the census figures in 1850. In 1860, the number of establishments was 21, all of which were in Pennsylvania. While these figures may be inaccurate, not over 100,000 tons of coke was manufactured by these furnaces in this

Presented before the Philadelphia meeting of the American Institute of Chemical Engineers, June 19-21, 1929.

year. In 1870, Ohio first appeared as producing coke. In 1880, the total production of the United States had risen to 2,752,475 tons, with a value of \$5,359,489. Of this, the Connellsville district alone produced over 68 per cent. Migration of this important industry, however, had begun. Four plants, with a capitalization of \$135,000, were operating in Alabama; one plant in Colorado showed an investment of \$150,000; four plants were operating in Illinois and fifteen in Ohio. There also were four in Tennessee, twelve in West Virginia, two in Virginia and one in Georgia, showing a spread of the industry much in keeping with the prevailing iron manufacture. Of the 1880 production, 84.2 per cent is credited to Pennsylvania (see Fig. 1).

The year 1900 found Pennsylvania still producing 67.4 per cent, but a definite migration to West Virginia and a new center of production in Alabama. The year 1919 shows a definite shift of coke plants to Ohio, Indiana, Illinois and Michigan. The year 1925 shows Illinois, Indiana and Ohio producing 36.3 per cent of the nation's production, Pennsylvania and New York 33.2 per cent, the percentage of West Virginia dwindling somewhat, and Alabama still producing over 7 per cent. The significance of these figures is partially lost, however, without a comparison of the gain in production in the passing of these decades.

In 45 years, the production of coke has increased from less than 3,000,000 tons in 1880 to more than 43,000,000 in 1919, and to more than 50,000,000 in 1925. This increase has also been remarkable in that the entire process has been revolutionized. In 1900, 95 per cent of the coke manufactured was by means of the beehive oven, while approximately 78 per cent of it was manufactured by the byproduct oven in 1925. The total actual investment in coke ovens was:

1880.....	\$4,768,858	Increase
1889.....	17,462,729	\$12,693,871
1899.....	36,502,699	19,039,970
1904.....	90,712,887	54,210,188
1909.....	152,321,337	61,608,450
1914.....	161,561,449	9,240,112
1919.....	365,249,622	203,688,173

In 1919, referring to the above, capital invested in byproduct ovens was \$227,342,747, over 62.2 per cent of the total investment, producing 66.6 per cent of the value of the production.

To Table I must be added large investments in Indiana, Michigan, Wisconsin, Colorado and other states, amounting to \$91,000,000.

An important byproduct of coke manufacture is gas, used both for industrial and domestic use. A general tendency may be observed for coke manufacture at or near population centers. Limiting factors are, first of all, the source of coking coal in the United States. Sec-

Table I—Capital Investment in Byproduct Ovens by States, 1880 to 1919

	1880	1899	1909	1919
Alabama.....	135,520	3,855,379	17,770,000	28,927,905
Illinois.....	205,000	X	X	25,931,172
Kentucky.....			X	4,765,766
Minnesota.....			X	9,508,411
New York.....		X	X	11,573,426
Ohio.....	X	X	X	48,242,369
Pennsylvania.....	144,012	84,690	1,238,000	125,341,038
Tennessee.....	200,021	617,322	858,000	2,035,359
Virginia.....	30,000	1,252,371	6,287,000	5,152,665
West Virginia.....	333,000	4,452,579	12,821,000	12,635,737

X—Not disclosed to avoid giving individual investments. Similarly figures are not given for other centers in Indiana, Colorado, Michigan and Wisconsin.

ondly, markets, chief of which is the iron industry. Next in order, probably, population centers with domestic consumption of gas and coke, and demand for industrial purposes, such as foundries, etc. Other metallurgical industries, such as lead and copper smelting, refineries, as well as various chemical plants may often have an influence in coke markets.

In 1880 while the manufacture of general chemicals had increased to a respectable sum of nearly \$118,000,000, only three companies produced 80,518 lb. of aniline colors, mostly from European intermediates, while 563,872 lb. was imported. In dyestuffs and extracts combined, the investment of capital in 1880 was \$2,363,700 and the value of the product \$5,253,038. In 1900 the capital investment had increased to \$7,838,034 and the value of products to \$7,350,748. Bearing in mind that these figures include also the manufacture of extracts and essentials, the after-War period figures are impressive.

The World War gave an immense impetus to the coal-tar, intermediates and dye industries, with some overcapitalization and over-production. In 1919, the value of these products was \$133,499,742, as compared with \$13,492,453 in 1914, and \$7,969,672 in 1909. Production of these materials in 1921 fell to a little over \$75,000,000, increased to \$121,000,000 in 1923 and fell off again to \$112,000,000 in 1925, showing the unstable condition of this class of manufacture.

There were 56 plants engaged in distillation of crudes, 99 plants manufacturing intermediates, and 106 plants manufacturing dyes and like colors in 1919. In 1925, there were 50 plants distilling crudes, 64 manufacturing intermediates and 74 producing dyes and finished coal-tar products.

A majority of these plants found location in the North Atlantic States, with the Middle West following. The year 1925 found considerable change, a number of consolidations, especially in manufacturing plants for intermediates and dyes, with a shift in size of plant and preponderance of manufacture definitely to the Atlantic seaboard.

Discussion of the alkali industry necessitates examination of the source of salt. Salt and the soda industries are so intimately related that it has been said that no alkali industry can prosper unless it practically sits on an adequate supply of salt. The early history of

"Increasing the capacity of the present plant, ruthless competitive measures, and well organized sales forces can not prevent the migration of industry. To meet this migration it becomes necessary for a competitive industry to establish branch plants in these migrating centers, or better, by engineering research to forestall such competition by determining the logical migrating points of industry and entering this field in advance of competition."



salt in the United States shows sporadic attempts by the early colonists to obtain salt from sea water, but until the discovery of salt deposits in New York, Pennsylvania and later in Ohio and Michigan, considerable salt was imported from Europe. By 1860 New York was producing 56.7 per cent of the salt manufactured in the United States; Pennsylvania, 8.4 per cent; Virginia, 17.5 per cent; and Ohio, 12 per cent. The great salt deposits of Michigan, Kansas and Louisiana had not, as yet, been brought into the picture.

Fig. 2 graphically shows the growth and migration of the salt industry from 1860 to 1925. From a value of \$2,289,000 in 1860, the industry has steadily increased its production, having a value in 1925 of over \$34,000,000. Of this, Michigan produced over 30 per cent; Ohio, 12 per cent; New York, 11 per cent; Kansas, 10 per cent, and Louisiana, 9.2 per cent.

Salt and alkali manufacture, irrespective of the trend of manufacture and the migration of population, localizes at the source of raw material. Of this, Chaplin Tyler says in his "Scientific Analysis of Industries": "Salt manufacture is a striking example of localization according to raw-material sources, about 70 per cent of the industry being in three centers of natural brines, Michigan, New York and Ohio. Fortunately these natural sources of salt are near large centers of population and are so distributed that transportation costs are minimized."<sup>1</sup>

Salt, however, is not a raw material in the distribution of which nature has been niggardly. Salt brines of varying concentrations are encountered in many localities. One of the first of these to be commercially exploited west of the Alleghenies was in southern Illinois, especially in Saline, Hardin and Gallatin counties. Here, in the early days of settlement, a primitive salt industry grew and flourished, utilizing salt brines of from 5 to 10 per cent concentration that flowed abundantly from wells of that district. Not until 1885 did production in this

and west. California and Nevada have produced considerable salt in the last two decades. Such localities as Louisiana, Texas, and Utah are hampered merely by distance from centers of population.

The capital investment and value of products is graphically shown in Table II. The striking fact to be noted in this table is that the capital invested exceeds largely the yearly value of production. This capital ratio shows disadvantageously from 1890 to 1920, although new capital invested shows a gain of nearly \$40,000,000. When we examine the investment and production of individual states, however, certain rather interesting facts are discernible. Thus, Michigan in 1920 produced \$14,000,000 worth of salt with capital investment of \$12,804,000, that is, with 26.9 per cent of the capital invested in the district, it produced 37½ per cent of the nation's salt. Similar comparisons may be made in Kansas, California, and Texas, all of which show low capital ratio. But New York produced only \$9,099,000 worth of salt with an invested capital of over \$15,000,000; Ohio, \$2,688,000 with invested capital of \$4,525,920; and West Virginia, \$213,000 with capital investment of \$847,944. The inferences are obvious.

**S**ODA, sodium bicarbonate, soda ash, caustic soda and salt cake usually are grouped in the salt industry. With the importance of these chemicals in such industries as the manufacture of glass, chemicals, soaps, paper, dyes and textiles, it is remarkable that these alkali industries were not developed earlier in American history.

As late as 1880 only one state, Pennsylvania, produced in three plants a little over 38,000,000 lb. of soda; Nevada gave us 1,800,000 lb. of natural product, while the importation from Europe was 360,000,000 lb., about nine times the domestic production. The development from that time on has been rapid; 1900 saw a production of soda and caustic to the value of almost \$12,000,000 and the approximate tonnage close to 1,000,000. Plants were

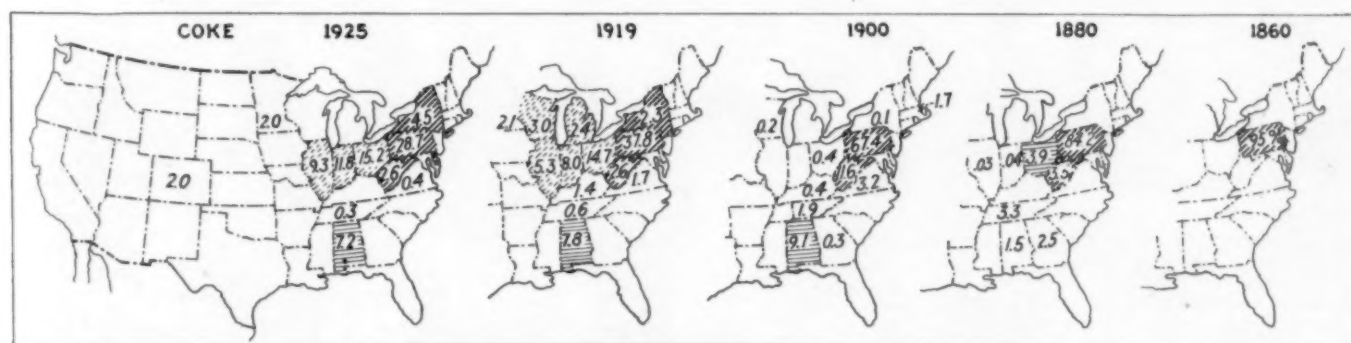


Fig. 1—Showing Westward Trend of Coke Industry

district cease because of competition from Ohio and Michigan.

The trend in salt production is toward the purer deposits and the more concentrated brines. This being true, it is natural that new centers will rapidly develop as population and industry inevitably shift to the south

operated in various favorable locations, and of these New York and Pennsylvania produced 51.4 per cent and the middle states 32 per cent. In 1921 Michigan, Ohio, New York, Virginia, and Kansas were the points of localization of the soda ash industry. These five states produce 98½ per cent of the 1,500,000 tons of soda ash manufactured. The situation of 1880 has been entirely changed and the United States is now exporting alkali. In the year 1921 Michigan, New York and Ohio produced 89 per cent of the 334,000 tons of caustic necessary for that year's chemical industry.

The preponderance of alkali manufacture has shifted definitely from New York to Michigan in a twenty-year

Table II—Capital Investment in U. S. Salt Industry

Year	Capital Invested	Value of Products
1879.....	\$8,225,740	\$4,829,566
1899.....	27,123,364	7,966,897
1909.....	29,011,793	11,327,834
1919.....	47,725,231	37,513,821

Note—Average salt prices for year 1910, \$1.89 per ton; 1914, \$2.11; 1919, \$3.93; 1925, \$3.54.

<sup>1</sup>"Chemical Engineering Economics," McGraw-Hill Book Company. New York, 1927.

period. Virginia, with a number of new plants, also shows a remarkable increase in its alkali production.

**T**HERE is no better index of the growth of technical and chemical industry than that of the manufacture of sulphuric acid. But sulphuric acid also has one great localized outlet; that of the manufacture of superphosphate fertilizer. Beginning with Ward's first chemical plant at Richmond, near London, in 1740, the manufacture of sulphuric acid was begun in France in 1766 and not until 1815 in Germany. Records are extant showing that John Harrison manufactured sulphuric acid in Philadelphia as early as 1793, his plant having a capacity of 300 carboys per annum. In 1829 there were two other manufacturers in Philadelphia and two in Baltimore. The 1850 census lists but four manufacturers of sulphuric acid, but there must have been at least twenty-five. All of these were, of course, small concerns. In 1880 the first real tabulation of the sulphuric-acid industry gives a production of approximately 200,000 tons. The Middle Atlantic States, New York, Pennsylvania, New Jersey, and Maryland producing 66 per cent; the New England States, 14 per cent, and the middle states, 15 per cent. In 1900 the shift had already begun to the Southern States on account of the growing demand for superphosphate fertilizer, although the total production in the South in that year was less than 5 per cent. The Middle Atlantic States still led the production with over 70 per cent. The 1919 census shows a total production (for sale) of over 3,331,000 tons with a value of \$35,932,000.

Sulphuric acid was in great demand for the manufacture of war materials, the United States government alone having plants with a capacity of over a million tons yearly. At the close of the War, many plants discontinued production or curtailed their output, but since 1919 the tonnage has steadily increased so that in 1925 the total tonnage was over 7,000,000 tons figured at 50 deg. Bé. acid. The shift of manufacture to the Southern

	1927	1928
Fertilizer manufacture.....	2,135,000	2,300,000
Petroleum refining.....	1,250,000	1,350,000
Chemicals.....	725,000	745,000
Coal products.....	732,000	740,000
Iron and steel.....	685,000	695,000
Other metallurgical.....	600,000	600,000
Paints and pigments.....	210,000	210,000
Explosives.....	183,000	170,000
Textiles.....	135,000	130,000
Miscellaneous.....	280,000	285,000
	<b>6,935,000</b>	<b>7,225,000</b>

The growth and migration of the fertilizer industry needs mention here. The fertilizer industry had its real inception in 1840, after the announcement by Liebig of his theories of plant nutrition. Before that time the natural manures were the only soil application worthy of note. Of the three mineral plant foods, nitrogen compounds, potassium compounds and phosphates, only the latter is manufactured on an adequate scale in the United States. Lack of natural deposits of potassium and the existence of a well developed source at Stassfurt, Germany, has led to our dependence on that source of supply.

During the World War, when these potassium salts were not obtainable, a hectic effort was made by the government to develop sources of supply. Potash lakes, green sands, fumes from cement plants and blast furnaces, beet-sugar residue, Pacific kelp beds and a number of other sources were developed; but now, ten years after the war, the Searles Lake potash development is practically the only project that may be said to have successfully weathered the renewed competition of German potash. Ammoniates from packing-house waste, natural manures, blood and bones, and natural nitrate from Chili have met competition from the manufacture of ammonium sulphate from coke and gas works and cyanamid by the electric-furnace process. We have heard much discussion about the manufacture of nitrates at Muscle Shoals. Recently, however, ambitious efforts to

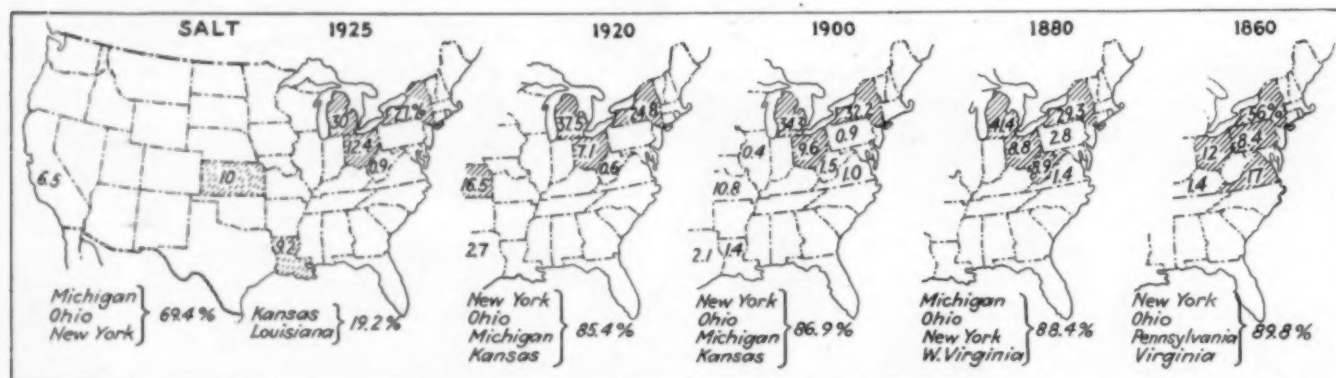


Fig. 2—Graphic Evidence of Increasing Importance of Newly Developed Centers of Salt Production

states has continued, still due to the increased use of superphosphate. Of this total the Atlantic states produced 32.8 per cent, the valley states 16.5 per cent and the Southern states 26 per cent.

Another large market for sulphuric acid is for the refining of petroleum oils. In few instances the geographic location is such that a manufacturer of sulphuric acid can serve both the fertilizer and petroleum industries.

Following are the estimates of consumption of sulphuric acid by industries, in short tons of 50 deg. Bé., for the years 1927 and 1928, as compiled by *Chem. & Met.* (Vol. 36, No. 1, Jan., 1929):

commercialize the Haber process of nitrogen fixation in the United States give promise of competition with natural nitrates.

Compared with this rather erratic development, the superphosphate industry has seen remarkable growth. Fig. 3 gives at a glance the localization of the fertilizer industry from 1860 to 1925. It will be seen that the bulk of the fertilizer plants in 1860 were centralized around Pennsylvania and New York, with practically none in the Southern states. Eighteen-eighty shows a distinct movement southward with over 12 per cent of the fertilizer manufactured in the Southern states. In 1900,



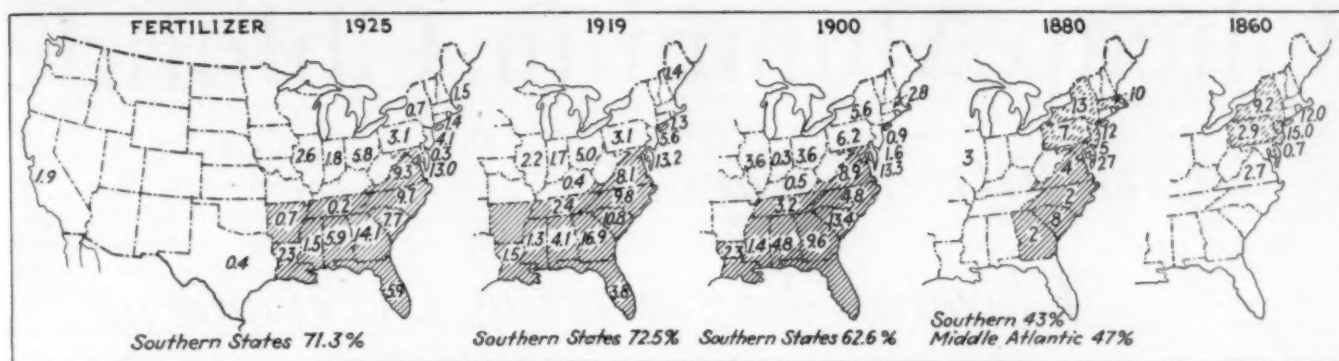


Fig. 3—Impressive Migration of Fertilizer Industry in the South Since 1860

478 plants produced nearly 3,000,000 tons of fertilizer; nearly 40 per cent of this was manufactured in the South. In 1919 there were 600 plants producing fertilizer to the value of \$281,000,000. Of this the Southern states produced over 55 per cent. This shift to the Southern states was due entirely to the manufacture of superphosphate. Other types of manufacture, especially mixed fertilizers, usually are compounded in the northern section. In this we see the manufacture of both sulphuric acid and fertilizer localized near the sources of raw material, distribution and market territory being secondary.

OTHER sign-posts pointing to industrial migration are those differences of capital ratio which may be discerned in a critical examination of various points of

Table III—Ratio of Capital Investment to Value Added by Manufacture  
CHEMICALS, 1920

	Capital	Value	Value Added	Tax	Ratio: Capital to Total Value	Ratio: Value Added to Total Value	Ratio: Tax to Capital
U. S. ....	\$484,488,421	\$438,658,869	\$222,357,590	\$31,931,389	110.4	50.7	6.5
Cal. ....	25,483,943	10,539,416	4,408,516	233,679	241.7	41.8	0.9
Ill. ....	19,923,193	22,060,803	10,057,729	647,408	90.3	45.6	3.2
Ind. ....	7,466,016	8,649,304	4,678,702	381,077	86.3	54.6	5.1
Md. ....	7,890,204	5,277,426	2,079,268	71,286	149.3	39.4	0.9
Mass. ....	16,318,388	17,305,166	9,203,749	738,196	94.3	53.2	4.5
Mieh. ....	62,841,234	37,850,834	22,106,759	2,399,240	166.5	58.4	3.8
Mo. ....	9,309,265	13,537,929	5,821,104	1,093,445	68.8	43.3	11.6
N. J. ....	90,993,211	84,033,941	38,860,347	3,060,252	108.2	46.2	3.3
N. Y. ....	91,909,454	88,101,532	37,230,140	5,413,813	104.3	42.2	5.8
Ohio. ....	26,764,298	32,719,466	17,423,937	1,740,048	81.8	53.8	6.4
Pa. ....	52,354,008	73,332,932	46,551,782	12,076,417	71.1	63.4	23.0
Va. ....	13,885,365	12,765,281	9,059,873	2,838,916	108.9	71.1	20.4

PAINT, 1920

	Capital	Value	Value Added	Tax	Ratio: Capital to Total Value	Ratio: Value Added to Total Value	Ratio: Tax to Capital
U. S. ....	\$177,314,815	\$256,714,379	\$91,110,253	\$5,638,099	69.6	35.5	3.2
Cal. ....	7,051,672	11,433,902	4,044,033	446,964	61.7	35.4	6.3
Colo. ....	1,289,008	1,168,001	479,419	51,926	110.4	41.1	4.0
Ga. ....	412,611	362,476	155,245	12,413	115.0	42.9	3.0
Ill. ....	27,648,999	43,061,694	13,426,181	592,709	64.3	31.3	2.1
Ind. ....	1,284,378	2,419,500	778,804	46,559	53.0	32.2	3.6
Iowa. ....	203,758	268,424	108,808	4,759	76.0	40.6	2.3
Ky. ....	1,386,528	2,786,468	886,992	76,075	49.8	31.9	5.5
Md. ....	2,142,270	3,376,725	982,658	17,081	63.5	29.4	0.8
Mass. ....	2,223,528	3,647,675	1,575,343	86,403	60.9	43.1	3.9
Mieh. ....	12,174,996	16,435,155	6,870,813	478,599	74.2	41.8	3.9
Minn. ....	1,948,735	2,512,132	901,160	167,350	77.6	35.9	8.6
Mo. ....	9,278,089	14,531,437	4,813,335	199,431	64.7	33.2	2.1
Neb. ....	891,730	1,307,556	625,338	50,800	68.1	47.7	5.7
N. J. ....	15,175,523	18,500,897	6,443,904	456,406	82.1	30.8	3.0
N. Y. ....	25,081,398	44,129,831	16,878,155	653,195	56.8	38.2	2.6
Ohio. ....	23,193,526	36,848,364	13,250,596	1,200,986	63.0	34.3	5.1
Pa. ....	31,685,058	35,747,820	12,280,255	651,719	88.7	34.4	2.1
Tenn. ....	785,796	1,520,669	491,088	10,412	51.7	32.3	1.3
Texas. ....	432,172	1,019,069	504,489	34,149	42.3	49.5	7.9
Vt. ....	1,088,074	1,141,775	427,730	13,828	95.4	37.5	1.2
Wash. ....	373,637	486,783	219,696	4,790	76.8	45.4	1.3
W. Va. ....	691,060	864,447	468,773	31,032	80.0	54.2	4.4
Wis. ....	5,152,930	6,702,258	1,652,073	255,344	77.0	24.6	4.9

concentrated manufacture. The capital ratio is defined as the ratio of capital invested to yearly production. This may be figured on total value of products, but is perhaps a more scientific indication of migrating influence if figured on the ratio of capital to value added by manufacture.

A more conservative method is to compare the capital ratio with the ratio of value added by manufacture to the total value of products. This method is here advocated. Where capital value is low and the value added by manufacture ratio is high as compared with other districts, more investment is justified. These ratios should be used with care, however. Unusual investments in certain localities may swell abnormally the capital investments; particular conditions often make capital investment high. It may be noted for instance that local manufacture of pig iron usually shows larger returns of added value than others. With these limitations in mind, points showing low capital investment coupled with high value ratios may be considered, generally, as points where added capital investments will appear in future compilations. Table III shows some of these ratios.

EXAMINATION has been made of the migration of industry from 1850 to the present day with a view to determining some of the factors influencing this migration. A number of industries have been discussed to show the magnitude of this migration and to point out the predominating factors. In general, the predominating factors influencing plant migration are: (1) The migration of population. (2) The shift of raw material centers. (3) The shift of predominating demand owing to new applications and inventions. (4) New sources of fuel or power—(a) Development of hydro-electric power. (b) New technical process for the utilization of inferior fuels. (c) Development of new fuel fields. (5) The exploitation of new sources of labor. (6) The development of centers of distribution; usually through freight territory demands and freight differentials.

It has been pointed out that strategic location for new plants may be determined by scientific research. That in these locations competitive industries will be established in spite of the dominance of the industry by strong companies in other localities. That increasing the capacity of the present plant, ruthless competitive measures, and well organized sales forces, are helpless to prevent the migration of industry. To meet this migration, it becomes necessary for a competitive industry to establish branch plants in these migrating centers, or better, by engineering research to forestall such competition by determining the logical migrating points of industry and entering this field in advance of competition.

# Cheap Aluminum Chloride

*After Fifteen Years of*

*Chemical Engineering Development*



*By A. M. McAfee*

*Superintendent, Aluminum Chloride Department,  
Gulf Refining Company,  
Port Arthur, Texas*

[EDITOR'S NOTE.—At the 1915 meeting of the American Institute of Chemical Engineers in San Francisco Dr. McAfee presented a paper on the aluminum chloride process of refining petroleum oils (see MET. & CHEM., vol. 13, pages 592-7, Sept. 15, 1915). Last month at the Philadelphia meeting of the Institute

the author gave the following paper, which vividly describes the chemical engineering difficulties met and solved in the fourteen years that have elapsed since his first pronouncement. Furthermore, during all of this period the process was in litigation—running the gamut from Patent Office interference to final and successful adjudication by the Supreme Court only within the past few months. Dr. McAfee's present paper is of broad significance not only as an example of successful chemical engineering development but also because it opens the way for the large-scale commercial use of anhydrous aluminum chloride as a raw material for the process industries.]

**I**N 1913 I purchased a few pounds of aluminum chloride for \$1.50 per pound. Six weeks were required to get it. Today Gulf Refining Company is manufacturing it at Port Arthur, Texas, from bauxite ore and chlorine at the rate of 75,000 lb. per day and at a cost that permits of its sale in carload lots at 5 cents per pound.

I have been somewhat amused by the remarks about the high cost of aluminum chloride which nearly always accompany the published references to its uses. Various authors say: It will do this and do that, *but*—and the usual "*but*" is that it is too expensive. The lowest figure that I have seen published heretofore is 15 cents per pound, and that seemed to be a wish rather than a reality.

Not until recent years has there been a determined and successful effort to make aluminum chloride cheaply and in large quantities. To Gulf Refining Company goes the credit of having first tackled and solved this problem. Here again necessity was the mother of invention. Gulf Refining Company was in possession of a process for making gasoline from higher boiling hydrocarbons and a process for refining petroleum oils in general and lubricating oils in particular by means of this remarkable chemical. The possibilities of these inventions were alluring but they were indeed fairy stories until aluminum chloride could be made from basic raw materials (not metallic aluminum) at a reasonable cost and by thousands of tons.

Our first attempt to make aluminum chloride in a large way was started in 1915. There was no precedent to which we could turn for help. We had to make the best guess possible and let Gulf Refining Company foot the bills, which it generously did for several long, lean years. The first apparatus consisted of vertical fireclay retorts about 24 in. inside diameter by 20 ft. in height. These were heated from the outside. The fireclay tile cracked from top to bottom. No aluminum chloride was made except when metallic aluminum was used, which of course was out of the question. Cost: six months' time and thousands of dollars. Then circular firebrick was substituted for the fireclay tile. This was an improvement, in so far as the firebrick did not crack under the heat of 1,600 deg. F., but chlorine is, as you well know, a lively agent at ordinary earthly temperatures; heat it to 1,600 deg. F. and it eats brick. This method was too expensive to be considered. Cost: Another six months and another several thousand dollars.

For trial No. 3 we called in the best ceramic experts





we could find and built retorts of porcelain, with ground joints, fired with outside producer gas to keep down hot spots. But chlorine at 1,600 deg. F., in the presence of carbon, devours porcelain quite as readily as firebrick. We were trying to make aluminum chloride by applying the necessary heat through retort walls to bauxite, carbon and chlorine. Where the heat should be greatest it was least and where it was most intense, along the retort walls, heat was not desired. At these temperatures it takes chlorine a surprisingly short time to eat a hole in a retort wall—and that hole does not get smaller.

The records show that we spent close to two years and one million dollars trying to make aluminum chloride from bauxite ore in a large way, without bringing the cost of production anywhere near a reasonable figure. We had come to realize that there were substantial reasons why this chemical had never been made in large amounts and why its cost was so often mentioned as prohibitive in the arts. But this time and money was not spent in vain. We learned many important details of how to do it and how not to do it. There were several more years of development work and each successive step proved to be one in the right direction, until today the process is one of extreme simplicity.

A few words about aluminum chloride condensers would not be out of place. This equipment also went through at development stage of trial and error with plenty of grief. If you ever had occasion to prepare aluminum chloride in the laboratory, you probably followed Gattermann's directions, which describe at some length how to avoid stoppage of the apparatus by aluminum chloride condensing where it is not wanted. Doubtless you were impressed with the importance of observing his precautions. As you know, aluminum chloride passes from the vapor to the solid phase, under substantially atmospheric pressure, without going through the liquid phase. It condenses quickly and makes about the best stopper that I know of.

Another problem was what material should be used for large-scale condensing and another, what design. In the early days we started out with a modest sized brick condenser with staggered baffles. This was connected as closely as possible to the chlorinating furnace.

The aluminum chloride had to be discharged by hand. This did fairly well for that scale of operation, but when we got into larger production the manual labor required to remove the product was found to be prohibitive. Another item which did not show up in the smaller condensers was even more serious. Carbon monoxide is one of the gaseous products of the reaction. The brick condensers used at that time were about 30 ft. long, 12 ft. high, and 6 ft. wide. This provided space



*Each of These Aluminum Chloride Stills Has a Capacity of 1,000 Bbl. per Day*

for the accumulation of sufficient carbon monoxide which when mixed with air, as would often occur, resulted in an explosion which would wreck the condenser.

Today all of our aluminum chloride is condensed in 16-in. iron pipes placed vertically. Revolving shafts and blades inside the pipes knock the aluminum chloride into hoppers as fast as condensed. The result is that the chemical is deposited in hoppers in the form of a powder, 75 per cent or more passing a 10-mesh screen. This fineness permits drawing the aluminum chloride through a sliding door into iron drums or other convenient receptacles. If aluminum chloride is permitted to condense and solidify undisturbed, as was the case with the old brick condensers, it builds up into a solid rock-like mass, ultimately plugging the condenser, no matter what the size. I have seen aluminum chloride

*Aluminum Chloride Plant of Gulf Refining Company at Port Arthur, Texas*



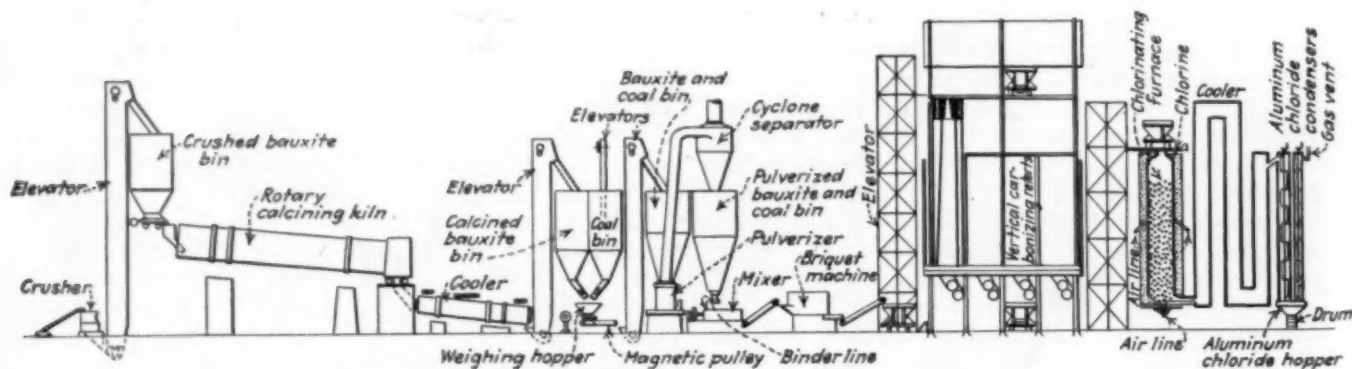
spudded out of the brick condensers in chunks weighing several hundred pounds each.

Aside from labor saving, the advantages of the present type condenser over the old type can readily be appreciated. The life of an iron pipe condenser such as I have described is at least two years. This is surprising in view of the fact that there is always some hydrogen chloride and often a trace of free chlorine in the condensers, particularly if the charge of briquets is allowed to become too low. The reason for this long life is that the inside pipe walls become coated with a thin layer of aluminum chloride which protects the iron from corrosion. Another item which adds to the longevity is the cooler, located between the chlorinating furnace and pipe condensers. The object of this cooler is to cool the aluminum chloride vapors to a temperature somewhat above their condensing temperature, thus increasing the capacity of the pipe condensers and minimizing the action of corrosive gases. It also acts as a trap for any bauxite or carbon coming from the chlorinating furnace. The cooler is generally lined with a single course of firebrick.

Recent improvement in the manufacture of aluminum chloride by Gulf Refining Company indicates the passing of the necessity for briquetting, substitutes refinery coke for coal, eliminates blasting the chlorinating furnace with air to restore heat, and seems to permit the enlargement of the furnaces to the size of, say, an iron blast furnace. It will be the policy of the Gulf organization to make aluminum chloride available to the public for all uses as freely as possible in excess of its own requirements and subject to royalty when used in its patented process and apparatus for converting and refining petroleum and its products. It is the expectation that the

tailings or melted asphalt. The mixers discharge automatically into briquetting machines which press the bauxite, coal and binder into briquets under a pressure of 3,000 lb. per square inch. Each briquet weighs approximately 2 lb. Before chlorinating, all hydrocarbons as well as moisture must be driven out of the charge, otherwise there will be a waste of chlorine as hydrogen chloride. Hence the briquets are preheated to approximately 1,500 deg. F., which drives out the volatile matter in the coal and leaves a hard briquet composed of approximately 82 per cent bauxite and 18 per cent carbon. The hot carbonized briquets are then charged to the chlorinating furnaces.

The largest chlorinating furnace which we have thus far built has a capacity of 40,000 lb. of aluminum chloride per day. It has an inside diameter of 5 ft. and the shaft is 20 ft. in height. The shaft consists of two courses of circular firebrick and behind these is a layer of powdered bauxite incased in an iron jacket. The object of the powdered bauxite is to protect the iron from chlorine. Near the top of the shaft are inlets for chlorine and near the bottom an outlet for aluminum chloride leading to condensers. This size furnace takes about 20 tons of carbonized briquets at a charge. These are introduced through an opening at the top of the shaft. A blast of air is then introduced near the bottom and also halfway up the shaft for about 15 minutes, at the end of which time the charge of briquets will have been heated to the desired chlorinating temperature of around 1,600 deg. F. The top door is then closed and chlorine turned in for a period of 8 to 10 hours, when it becomes necessary to replenish the charge of briquets and restore heat. With smaller size chlorinating furnaces it is necessary to recharge and restore heat more frequently. Thus the operation proceeds in any particular furnace until the firebrick lining must be renewed. Under present operating practice a lining is good for about 100 days.



Diagrammatic Flow Sheet of the Gulf Process for Manufacture of Commercial Anhydrous Aluminum Chloride

present price of 5 cents per pound will shortly be lowered to even more attractive figures.

Details of the present process, which has been operating successfully for several years, are as follows: Crude bauxite ore, which should be reasonably low in silica and iron, is calcined in an internally heated rotary kiln at about 1,800 deg. F. to drive off the free and combined moisture, which usually amounts to about 40 per cent of the ore. From the kiln the bauxite is delivered by belt conveyor and bucket elevator to a weighing hopper, where is added a good coking coal in the proportion by weight of approximately 3 parts of bauxite to 1 part of coal. The mixture of bauxite and coal is then put through a pulverizer where the two solids are ground to a powder. From here it is directed to overhead hoppers which feed into mixing vats to which is delivered a liquid binder, such as wax

I have tried to indicate throughout this paper that this development has not been a one-man job. It has required the combined efforts of many men pulling together, all of whom are now, or at some period have been, a part of the Gulf organization. Some of us may have spent more days and nights on the problems in the early years of development, and, as a consequence, may have come into contact with more grief, but that does not matter now. It seems fitting that I should mention one in particular, whose personality and leadership inspired us to overcome difficulties which many times seemed insurmountable. I refer to George H. Taber, formerly vice-president of Gulf Refining Company, who retired on Dec. 31, 1928, after 52 years of notable service in the petroleum industry.



# Calculating Lignite Drier With Psychrometric Chart

By Irvin Lavine and R. L. Sutherland

Assistant Professor of Chemical Engineering and Fellow in Lignite Research, Respectively, University of North Dakota, Grand Forks, N. D.

**E**NGINEERING problems relating to the drying of hygroscopic materials can be solved by means of physical equations derived from theory and substantiated in practice. However, these problems may be solved more readily with the aid of the psychrometric chart given in Fig. 1, which is a reproduction, on a reduced scale, of a chart prepared by the authors (*Chem. & Met.*, April, 1928, p. 224) for use in drying calculations.

The application of the psychrometric chart to the solution of a practical problem will be illustrated, using data obtained in drying lignite with waste stack gas in a direct-contact drier of semi-commercial size installed

\*The calculations in this paper were made from a chart slightly over ten times as large as the one given here. Thus the authors are able to read to about one more decimal place than the reader can expect, although the chart given here will be found to be sufficiently accurate for most engineering calculations. If the reader should desire to construct his own high-temperature chart on a larger scale, he is referred to the prior article (*Chem. & Met.*, April, 1928, p. 224), where complete data for ready use will be found.

in the power plant of the University of North Dakota. The average specific heats of air and combustion gas being approximately equal, the values shown on the chart are sufficiently exact for practical purposes.\*

The accompanying psychrometric chart is based on absolute humidity. It is therefore necessary to convert all relative humidity values into terms of percentage humidity. This may be done by multiplying relative humidity by the conversion factor

$$\frac{29.92 - p_s}{29.92 - p} \quad \text{where}$$

$p$  = partial pressure of the water vapor in any mixture

$p_s$  = partial pressure of water vapor in the saturated mixture at the same temperature.

Thus at a temperature of 148 deg. F., a 60 per cent relative humidity corresponds to a humidity of

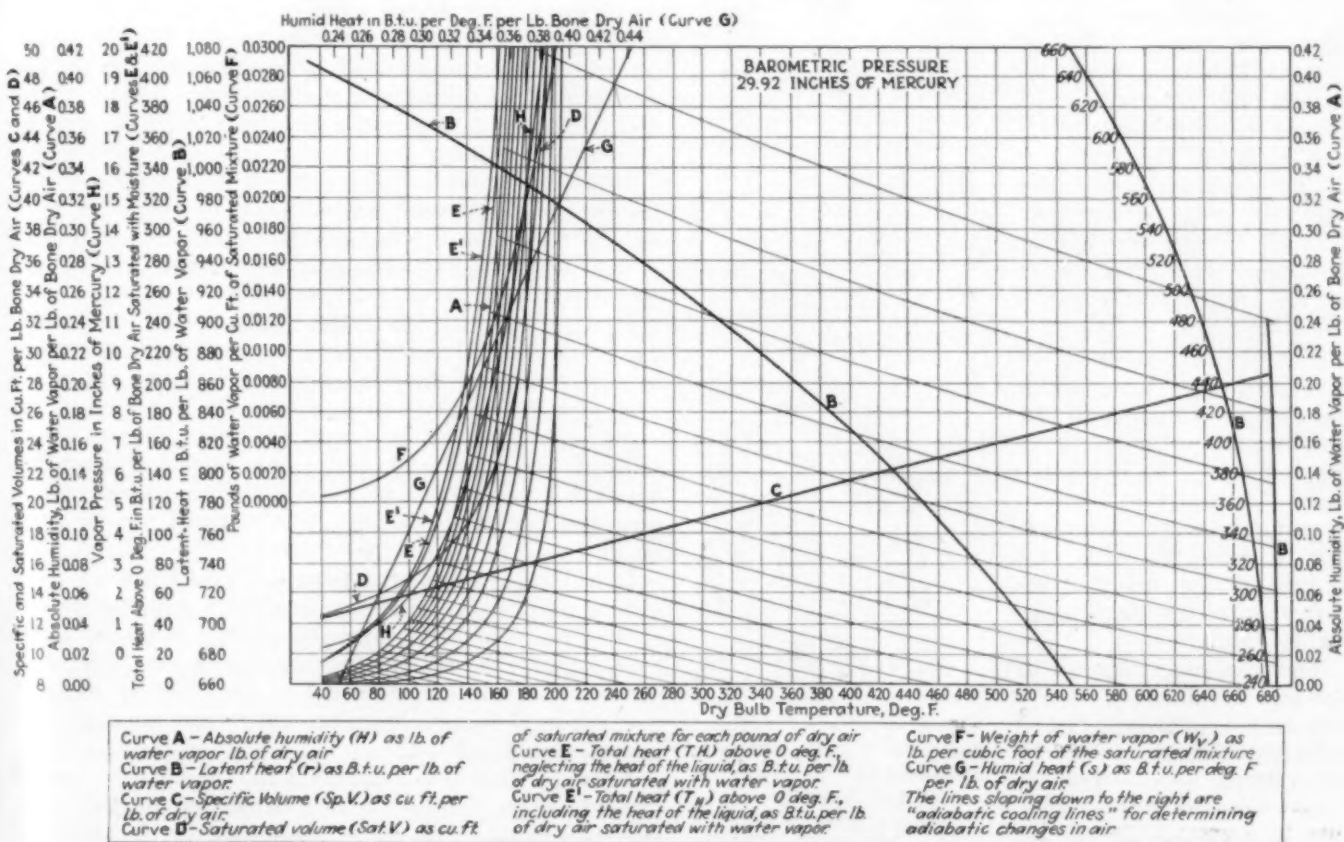


Fig. 1—Psychrometric Chart for High-Temperature Calculations on Air and Gases Having Similar Specific Heats

$$0.60 \times \frac{29.92 - 7.195}{29.92 - (0.6 \times 7.195)} = 53.2 \text{ per cent}$$

where

7.195 = vapor pressure in inches of mercury of a saturated mixture at 148 deg. F. This can be obtained directly from the chart.

In Fig. 2 is given a series of curves by means of which it is possible to convert relative humidity to percentage humidity without calculation.

Hygroscopic materials, upon exposure to the atmosphere, lose or gain moisture, depending upon the nature of the material and the temperature and humidity. Even when in contact with unsaturated atmospheres they retain a certain amount of moisture. A review of the literature indicates that in the drying of these materials special consideration must be given to the conditions of temperature, humidity, velocity and direction of flow of the drying medium. Also, the drying without injury of such materials as coal, textiles, leather, soap, paper, green lumber, chemicals and ceramic materials depends in a large measure on their physical and chemical properties.

Carrier and Stacey (W. H. Carrier and A. E. Stacey, Jr., *Ind. Eng. Chem.*, 13, 438, 21) pointed out that in the drying of hygroscopic materials two critical points with respect to relative humidity must be considered. In the first stage free or non-hygroscopic moisture is removed, in which case a high relative humidity must be maintained to prevent hardening and shrinkage of the exterior. For many materials a relative humidity of at least 80 per cent is required for this purpose. In the second stage only hygroscopic moisture is removed and in many cases a certain amount of this moisture must be retained to prevent physical injury. This may be accomplished by maintaining a definite vapor-pressure gradient between the moisture in the material and the moisture in the drying medium. This gradient will be determined to a large extent by the nature of the material being dried.

The limiting factor in the drying of such materials is the rate of diffusion of the moisture from the interior to the surface. The maximum rate of diffusion is obtained by using the highest temperature consistent with the nature of the material together with the proper humidity gradient.

The moisture content of lignite as mined in North Dakota ranges from 32 to 43 per cent, with an average of about 36 per cent. Upon exposure to the air it loses moisture to a greater or less extent, depending upon the

temperature and humidity. According to the reports of the U. S. Weather Bureau the relative humidity in the state ranges from 63 to 80 per cent. Laboratory and air-drying tests indicate that for these limits the equilibrium moisture contents of lignite are 18 and 22 per cent respectively. In drying for storage, therefore, it is impracticable to reduce the moisture content below about 18 per cent.

Drying usually is accompanied by disintegration or "slacking," which may be attributed to the rapid loss of moisture from the surface of the lignite without a corresponding loss from the interior. In the preparation of partly dried lignite for use in some types of combustion equipment it is essential that disintegration be minimized. The excessive heat loss in stack gas from the combustion of the high-moisture lignite may be reduced and the high initial saturation temperature of the gases utilized to effect partial drying with minimum disintegration.

#### TYPICAL PROBLEM

Lignite of 36 per cent moisture, entering the drier at 50 deg. F., is to be dried to a moisture content of 20 per cent. Waste stack gas from the combustion of lignite under a steam boiler is to be used as the drying medium. The average dew-point temperature of this gas is 125 deg. F. with a dry-bulb temperature of 600 deg. at the drier inlet. The required humidity of the drying gas will be controlled by recirculation of saturated exit gas.

The relative vapor pressure of the moisture in the lignite decreases progressively from 100 to 75 per cent as the moisture content is reduced from 36 to 20 per cent (unpublished Univ. of N. D. Division of Mines Research Report). Therefore the relative humidity of the drying atmosphere must be reduced in the same ratio to maintain a balance between diffusion to, and evaporation from, the surface. If the relative humidity at the beginning of the drying process is to be 80 per cent, at the end it must be 60 per cent. The humidity gradient will be maintained by passing the drying gas counter to the movement of the lignite through the drier.

In its simplest form the drying operation may be considered as taking place in two stages:

1. A period in which the available heat content of the drying gas is all used in warming the material to a definite temperature of evaporation which is determined by the initial and final saturation temperatures of the drying gas.

2. A period in which all the available heat in the drying gas is used in the adiabatic evaporation of moisture without change in the temperature of the material.

In practice, using direct-contact methods, warming and evaporation are not thus sharply defined. The two stages proceed simultaneously and consequently evaporation does not all take place at the same temperature. However, the calculations of the heat required can be made on this basis without serious error.

It will be assumed that the gas leaves the drier completely saturated. Such a condition can be closely approximated in drying by direct-contact methods. However, since the calculations are based on differences between the absolute humidity of the entering and exit gas, the method of calculation will be the same for exit gas of any saturation.

Loss of heat by radiation, the amount of which depends upon the type and construction of the drier, may be treated in the same manner as the heat required for warming the material.

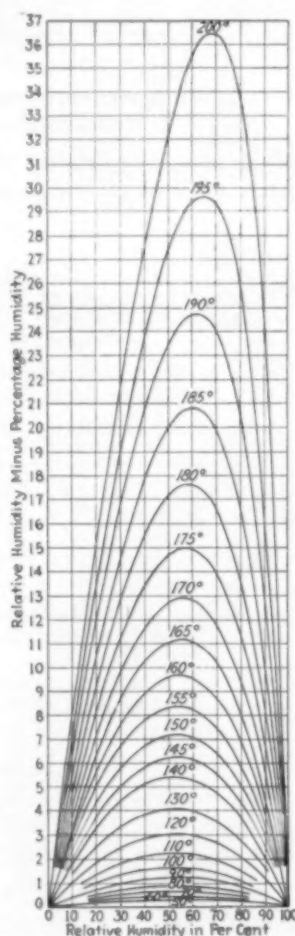


Fig. 2—Curves for Converting Per Cent Relative Humidity to Per Cent Absolute Humidity

Subtract amount of ordinate from per cent relative humidity to get per cent absolute humidity



The necessary calculations will involve the determination of:

1. The temperature of evaporation.
2. The heat required to warm the material to the temperature of evaporation.
3. The heat required for evaporating the moisture.
4. The weight of dry gas at the initial saturation and dry-bulb temperature required to supply the heat and to carry out the moisture.
5. (a) The weight and (b) the saturated volume of the gas leaving the drier.
6. (a) The total weight and (b) the total volume of gas, saturated at the outlet temperature, in circulation to maintain an atmosphere of 60 per cent relative humidity.
7. (a) The weight and (b) the saturated volume of gas recirculated.

#### CALCULATIONS

**1. Temperature of Evaporation**—As a first approximation, assume all the heat available in the drying gas is used in evaporating water. On this assumption, the approximate temperature of evaporation is obtained from the psychrometric chart as follows.

From the intersection of the horizontal line through a temperature of 125 deg. on the 100 per cent saturation curve marked "A" with the vertical line through a 600-deg. dry-bulb temperature, follow the adiabatic cooling line to the 100 per cent saturation curve at a temperature of 151.6 deg. This is the approximate temperature of evaporation.

**2. Heat to Warm Material**—The heat required for warming unit weight of material to the temperature of evaporation may be calculated from the following equation:

$$[t_w - t_e][(WC_{pw}) + (1.00 - W)C_{pm}] \quad (A)$$

where

$t_w$  = temperature of evaporation

$t_e$  = temperature of material entering drier

$W$  = weight of moisture per pound of material as charged

$C_{pw}$  = mean specific heat of water. For all practical purposes this may be taken as unity

$1.00 - W$  = weight of bone-dry material per pound of material as charged

$C_{pm}$  = mean specific heat of the bone-dry material.

Substituting the values of the problem in the above equation, the heat required for warming the lignite to the temperature of evaporation equals

$$[151.6 - 50][(0.36 \times 1) + (0.64 \times 0.25)] = 52.8 \text{ B.t.u.}$$

**3. Heat to Evaporate Moisture**—The heat required for evaporating the moisture in B.t.u. per pound of material as charged is

$$r_w W_e \quad (B)$$

where

$r_w$  = latent heat of water vapor at  $t_w$

$W_e$  = weight of water to be evaporated per pound of material as charged.

The latent heat of water vapor at 151.6 deg. can be determined from the chart by following vertically from this temperature on the 100 per cent saturation curve to the latent heat curve marked "B," reading a value of 1,006.3 B.t.u. on the corresponding scale to the left. To dry 1 lb. of lignite from a moisture content of 36 per cent to 20 per cent requires the evaporation of 0.2 lb. of water per pound of lignite as charged. Substituting

these values, the heat required for evaporating the moisture equals

$$(1,006.3)(0.2) = 201.2 \text{ B.t.u.}$$

The total heat required for warming and evaporating is, therefore

$$52.8 + 201.2 = 254 \text{ B.t.u.}$$

**4. Weight of Supply Gas**—The weight of dry gas at the initial saturation and dry-bulb temperature required to supply the heat and carry out the moisture is calculated as follows: The heat available in B.t.u. per pound of dry gas is

$$S(t_d - t_w) \quad (C)$$

where

$t_d$  = initial dry bulb temperature of the drying gas

$t_w$  = temperature of evaporation

$S$  = humid heat at the initial saturation temperature of the drying gas.

The humid heat of the initial gas is determined from the chart by passing horizontally from the 125-deg. point on the 100-per-cent saturation curve to the humid heat curve marked "G," chart as 0.286. Therefore, 1 lb. of dry gas, saturated at 125 deg., in cooling adiabatically from 600 to 151.6 deg. will liberate

$$(0.286)(600 - 151.6) = 128.2 \text{ B.t.u.}$$

Therefore, the weight of gas required per pound of lignite as charged equals

$$\frac{254}{128.2} = 1.98 \text{ lb.}$$

In warming the lignite, each pound of gas gives up

$$\frac{52.8}{1.98} = 26.6 \text{ B.t.u.}$$

This will be accompanied by a corresponding drop in temperature of the gas, equal to

$$\frac{26.6}{0.286} = 93 \text{ deg.}$$

Hence, the dry bulb temperature of the gas, available for evaporation, after allowance is made for the heat required to warm the lignite, is  $600 - 93 = 507$  deg.

#### RECALCULATION

**1. Temperature of Evaporation**—A closer approximation to the true temperature of evaporation can now be obtained. Follow the adiabatic cooling line from the intersection of the horizontal through the 125-deg. point on the 100-per-cent saturation curve with the vertical

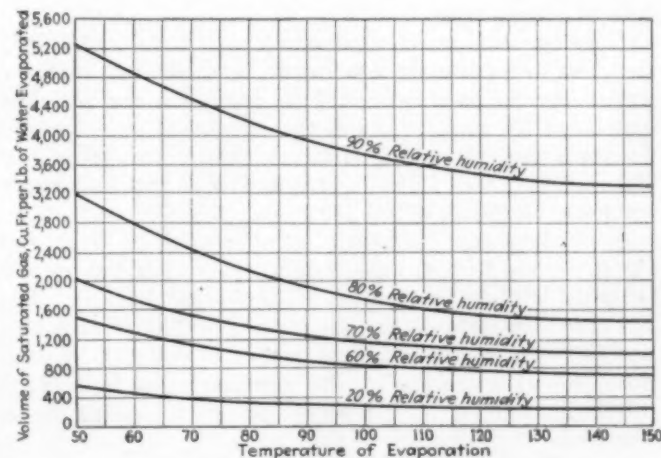


Fig. 3—Saturated Volume of Gas in Circulation Per Pound of Water Evaporated

line through a 507-deg. dry-bulb temperature to the 100-per cent saturation curve at a temperature of 147.9 deg.

2. *Heat Required for Warming*—By equation (A)  

$$[147.9 - 50][(0.36 \times 1) + (0.64 \times 0.25)] = 50.9 \text{ B.t.u.}$$

3. *Heat Required for Evaporating*—By equation (B)  

$$(1008.4)(0.2) = 201.7 \text{ B.t.u.}$$

where 1008.4 B.t.u. = latent heat of water vapor at 147.9 deg.

4. *Weight of Supply Gas*—The weight of dry gas at the initial saturation and dry-bulb temperature required to supply the heat and carry out the moisture is again determined: Heat available per pound of dry gas, by equation (C) is  $(0.286)(600 - 147.9) = 129.3 \text{ B.t.u.}$  Pounds of gas required per pound of lignite as charged equal

$$\frac{252.6}{129.3} = 1.95 \text{ lb.}$$

In warming the lignite, each pound of gas gives up

$$\frac{50.9}{1.95} = 26.1 \text{ B.t.u.}$$

The temperature drop will therefore be

$$\frac{26.1}{0.286} = 91.3 \text{ deg.}$$

and the corrected dry-bulb temperature will equal  $600 - 91.3 = 508.7 \text{ deg.}$

A still more accurate determination of the temperature of evaporation can be obtained, as before, by using a dry-bulb temperature of 508.7 deg. An evaporating temperature of 147.95 deg. is obtained.

Since the heat absorbed in adiabatic cooling is all latent in the saturated vapor, a check on the above calculations can be obtained by determining the final absolute humidity of the gas. The weight of water vapor added per pound of dry gas is

$$\frac{0.2}{1.95} = 0.10256 \text{ lb.}$$

The initial saturation at 125 deg. is found from the chart to be 0.0942 lb. of water vapor per pound of dry gas. The final saturation of the exit gas, therefore, is  $0.10256 + 0.0942 = 0.1967 \text{ lb. of water vapor per pound of dry gas.}$

The temperature corresponding to this absolute humidity is found from the chart to be 147.9 deg., which approximates very closely the temperature of 147.95 deg. as determined above. The temperature of 147.9 deg. will be used in the calculations as the correct temperature of evaporation.

Since the evaporating temperatures of 147.9 and 147.95 deg. are in such close agreement, it is obvious that the values for the heat necessary to warm the material and evaporate the moisture, and the weight of gas required for this purpose as determined above, viz., 50.9 and 201.7 B.t.u. and 1.95 lb., respectively, are sufficiently accurate for all practical purposes.

5. *Weight and Saturated Volume of Exit Gas*—(a) As determined above, the weight of dry gas leaving the drier is 1.95 lb. per pound of lignite as charged. The absolute humidity of the gas leaving the drier saturated at 147.9 deg. is 0.1967 lb. per pound of dry gas. Therefore the total weight of the saturated gas is  $1.95 + (1.95 \times 0.1967) = 2.3336 \text{ lb. per pound of lignite as charged.}$

(b) The saturated volume per pound of dry gas at 147.9 deg. is found from the chart to be 20.12 cu.ft.

Therefore the total saturated volume per pound of lignite as charged equals

$$1.95 \times 20.12 = 39.2 \text{ cu.ft.}$$

In the above calculations the weight of the gas at the initial saturation and dry-bulb temperature required to furnish the necessary heat for warming the lignite, as well as for evaporating and carrying out the moisture, have been determined. The humidity of the drying atmosphere, however, does not meet the requirement specified in the problem to prevent disintegration.

6. *Weight and Volume of Circulating Gas*—The total weight and total volume of gas saturated at the outlet temperature and in circulation are now to be determined.

(a) The dew point temperature of a gas of 60 per cent relative humidity, having a wet-bulb temperature of 147.9 deg., is obtained directly from the chart by passing horizontally from the intersection of the 147.9 deg. adiabatic cooling line with the 53.2-per-cent humidity curve to the 100-per-cent saturation curve at 147.2 deg. The corresponding absolute humidity is (from the chart) 0.1911 lb. In becoming saturated at 147.9 deg. 1 lb. of dry gas of 53.2 per cent humidity will evaporate

$$0.1967 - 0.1911 = 0.0056 \text{ lb. of water.}$$

Hence, the evaporation of 0.2 lb. of water requires

$$\frac{0.2}{0.0056} = 35.78 \text{ lb. of dry gas}$$

The total weight of saturated gas, therefore, equals  $35.78 + (35.78 \times 0.1967) = 42.82 \text{ lb.}$

(b) The total volume of saturated gas equals  $35.78 \times 20.12 = 720 \text{ cu.ft.}$

The volume of saturated gas in circulation for atmospheres of 90, 80, 70, 60, and 20 per cent relative humidity and evaporating temperatures from 50 to 150 deg., required to evaporate and carry out 0.2 lb. of moisture, can be read directly from the curves in Fig. 3. The values used in plotting the curves were calculated from the following expression

$$\left( \frac{W}{H_2 - H_1} \right) (S.V.)_{t_2} = \text{cu.ft. of saturated gas}$$

where

$W$  = weight of moisture to be evaporated

$H_2$  = absolute humidity at  $t_2$ , the temperature of evaporation

$H_1$  = absolute humidity at the initial saturation temperature of the drying gas

$(S.V.)_{t_2}$  = saturated volume at  $t_2$ .

7. *Recirculated Gas*—The weight and saturated volume of gas recirculated to maintain the proper drier atmosphere are:

(a) The weight of dry gas recirculated equals  $35.78 - 1.95 = 33.83 \text{ lb.}$  The corresponding weight of saturated gas is  $33.83 + (33.83 \times 0.1967) = 40.48 \text{ lb.}$

(b) The saturated volume of gas recirculated equals  $33.83 \times 20.12 = 681 \text{ cu.ft.}$

*Summary*—The above calculations show that in drying 1 lb. of lignite from a moisture content of 36 per cent to 20 per cent, under the conditions specified: (1) the temperature of evaporation is 147.9 deg.; (2) 1.95 lb. of dry gas, saturated at 125 deg. is required to furnish the heat and carry out the moisture; (3) 39.2 cu.ft. of gas, saturated at 147.9 deg., must be removed from the drier; (4) 720 cu.ft. of gas, measured at a saturation temperature of 147.9 deg., must be circulated through the drier to maintain the required humidity, of which, (5) 681 cu.ft. is the saturated volume of exit gas recirculated.



# Glass Plates Prolong Life of Distilling Columns

By A. A. Backhaus

Vice-President, U. S. Industrial Alcohol Company,  
Baltimore, Md.

IN 1923 the writer discussed with A. E. Marshall, consulting engineer for the Corning Glass Works, the problem of making distilling column plates of glass. The possibility of both the perforated and the bonnet type of distilling plate was considered. Within a short time samples of glass disks 13 in. in diameter, perforated by sand blast, were submitted. The cost of producing perforations in this manner was prohibitive.

Further discussions with Mr. Marshall finally resulted in a bonnet type glass plate design which would be possible from the standpoint of glass practice and at the same time make a practical job for distillation work. The photograph in Fig. 1 shows the assembly of one plate, which measures 24 in. in diameter.

The vapor pipes, as well as the down pipe socket, are integral with the plate. The peripheral rim is tapered to provide for packing the joint between plate and column shell. The bonnets are of the rectangular or trough type with toothed edge. Each bonnet rests upon two vapor pipes, is kept from shifting by inside corner lugs and held down by a glass spacer cylinder, fitting between the top of the bonnet and the plate above. A boss on the bonnet holds the cylinder in place.

In the fall of 1926, a 24-in. diameter 30-plate distilling column was built using internal glass parts. The shell consists of lead-lined steel column sections flanged and designed to accommodate two plates to each section. Assembly details will be clear from the drawing. The plate midway in the section is supported by a 1x1-in. lead ring burned to the shell lining. The other plate is supported by a flat lead ring bolted between flanges and projecting inside the shell lining to form a shelf. Asbestos-sodium silicate was tamped in to fill the space between glass periphery and the shell. A  $\frac{1}{8}$ -in. lead wire was placed on top of the packing.

This column has been in use two years for distilling anhydrous solutions containing alcohol and hydrogen chloride. As is well known, corrosion is greatly in-

Extracted from paper read before Philadelphia meeting of American Institute of Chemical Engineers, June 19-21, 1929.

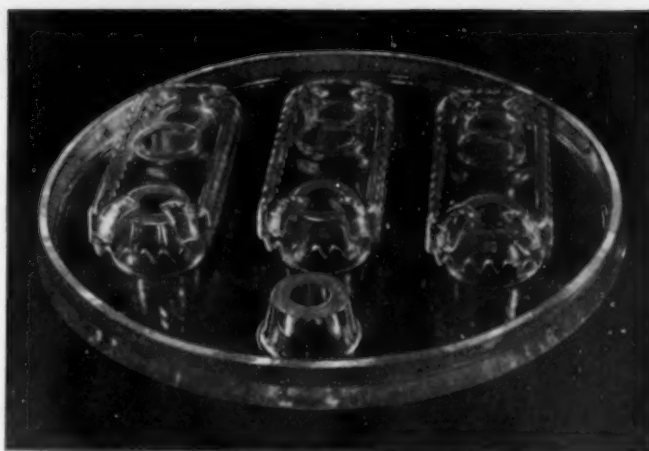


Fig. 1—Assembly of Bonnet-Type Glass Plate

creased when erosion occurs simultaneously. In a distilling column the plates, and especially the bonnets, are subjected to the erosion of a violently boiling liquid. Corrosive liquids under these circumstances make a column short-lived. Lead plates used for the job in question lasted only a few months while the lead lining of the shell showed good life. The use of glass plates has here resulted in a useful combination.

The Corning Glass Works have arrived at a satisfactory solution of the perforated plate for distilling columns. In 1926 Mr. Marshall exhibited small samples of a new and apparently practical method of perforation. Drawings and specifications were submitted to the Corning Glass Works showing design to meet our requirements. After a number of revisions a final design was agreed on and molds made. The final results are also shown in a drawing, Fig. 2. Details as to dimensions may be found by reference to this scale drawing.

Several columns have been built with twenty perforated glass plates per column. A lead-lined, flanged, cast section is used for each plate. Seamless lead tubing 12 in. in diameter was used to line the iron section. A tight joint between the plate and the shell is made by the use of a lead ring around the glass plate periphery. This ring is set between section flanges and as the flange bolts are drawn down tight the lead squeezes inward as well as outward, making a tight fit around the glass.

The author acknowledges assistance rendered in this work by D. B. Mason and others of the technical staff of the United States Industrial Alcohol Company.

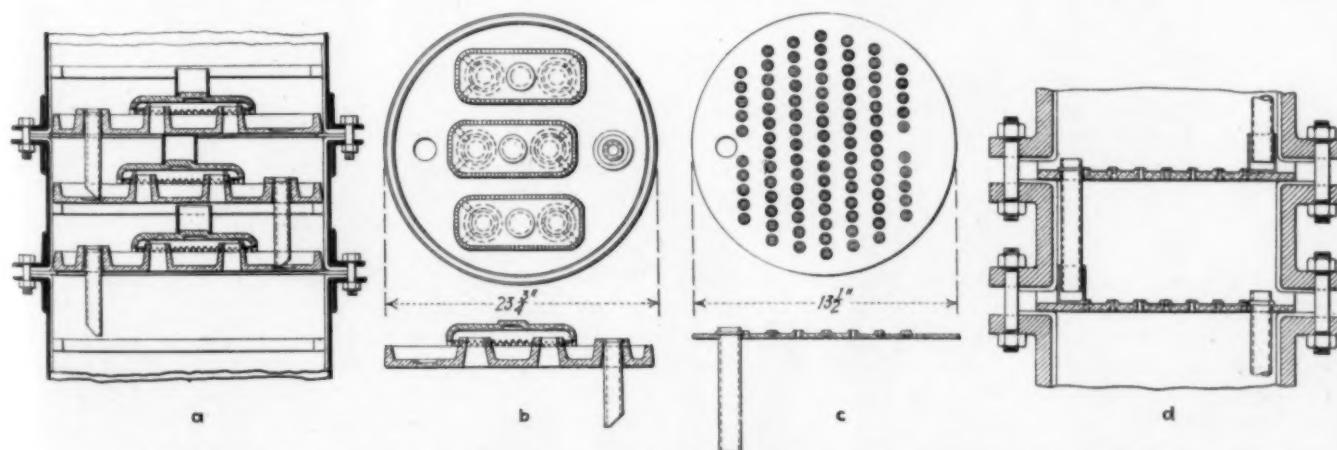


Fig. 2—Construction Details and Assemblies of Glass Plates for Distilling Columns

(a) Glass plate distilling column assembly; (b) glass distilling plate; (c) perforated glass distilling plate; (d) perforated glass distilling plate assembly.

# CHEMICAL ENGINEER'S BOOKSHELF

## American Potash Outgrows Its Infancy

INDUSTRIAL DEVELOPMENT OF SEARLES LAKE BRINES, WITH EQUILIBRIUM DATA. By John E. Teeple and Associates of the American Potash & Chemical Corporation. Chemical Catalog Company, New York, 1929. 182 pages. Price, \$3.50.

Reviewed by PAUL D. V. MANNING

DR. TEEPLE'S talks and papers are both invariably interesting to the capitalist, executive, layman, chemist and engineer. The reason, no doubt, is that he has a broad understanding of the problems and viewpoints of all and has the ability to express this understanding in a modest manner as entertainingly by writing as by speaking. The first part of this book can be read by all of us with an almost breathless interest and there is enough humor in it to bring many a good chuckle.

We also find another rarity in this book: an accurate review of its contents by the author. Dr. Teeple has given such a review in the preface much better than it can be done here. Necessarily, then, we must take the opportunity of quoting it to a considerable extent.

To the reviewer it seems that the most important lesson from the book is given in Dr. Teeple's statement of its second purpose: "to give a short story of the application of research, technology and common sense to the development of a potash and borax business. This story of the diagnosis of a situation in an industry and the course of development which led to success is not such an uncommon thing; in fact it is all in the day's work, so why write a book about it? The answer lies in the very peculiar attitude that was manifested toward the development of a potash industry in this country. During the World War potash was news. Anyone could be sure of making the front page by talking about potash and how this country was becoming independent of Germany.

"With peace came a change. College professors, bankers, business men, chemists and ministers of the Gospel now granted interviews freely to prove that this country could not hope to produce potash successfully in times of peace. Many of the interviews, possibly inspired, were circulated by a well-known advertising agency. The opposition to American potash was apparently deep seated, based on faith and belief rather than on facts or logic. Few things are more aggravating and often harmful than loud and dogmatic assertions that a given thing cannot be done, coming from people who obviously are in no position to judge whether it can be or not. I think we all react to this in much the same way; we look back of the loud speakers to see who is broadcasting; that tells us who is most afraid that the thing will be done; then we proceed to do it. The plant at Trona undertook to manufacture two staple products, potash and borax, in competition with two world monopolies. . . . Since the record that it could not be done was so voluminous it seems well to make note of the fact that it has been done.

"This book does not contain detailed descriptions or processes, nor scale drawings of apparatus. The former are not so antiquated nor the latter sufficiently obsolete to permit their publication yet. Anyone intelligent

enough to use that kind of information will know better than to expect it here."

The second part of the book gives the equilibrium diagrams and data for 32 multi-component systems which involve most of the components found in the salines of Searles Lake, beginning with the less complicated and proceeding to systems involving all of the major components.

The book is certainly a gem and an inspiration. The first part should be read and studied by every scientific man and by every young chemist before he starts out to get his first job; the understanding of the viewpoint expressed is very worth while and will aid him in his work.

As to the mechanics of the book, one wishes it were printed on a paper which would show the illustrations better and that the type used in the legends on the faces of the diagrams were larger. It does not do the author justice.

\* \* \* \*

## Tracking the Rare Gas to Its Lair

THE DISCOVERY OF THE RARE GASES. By M. W. Travers. Edward Arnold & Company, London, 1928. American distributors, Longmans, Green & Company, New York. 128 pages. Price, \$6.

Reviewed by R. S. McBRIDE

A RECORD of the investigations which led to the discovery, identification, and early study of argon, helium, krypton, neon, and xenon, by one who had a very large personal part in the work, is particularly welcome. This volume is, indeed, a very valuable historical document; more than this, it is an inspiring story presented in very readable fashion of a classic series of researches.

Even one not at all interested in the history of chemistry or in the subject of rare atmospheric gases would find stimulus for better investigation and for greater persistence in search from a reading of this book. The story is charmingly presented, including the failures as well as the successes of a decade of intensive investigation. Not a little of the philosophy of the workers can be gained from the following short sentence which reflects the persistence as well as the diligence of these men: "It was a messy job and nothing came of it; yet it was an experiment worth trying." Indeed, their work is largely a picture of experiments worth trying, even though the promise of success at times seemed very small.

The reviewer regrets to record one serious failing of the book: its inaccuracy in dates and names. Even the careless reader will discover at many points through the book dates which obviously are incorrect. One whole chapter title carries a date which is ten years in error, as evidenced by the context. At numerous other points throughout the book statements refer to earlier work but state later calendar years where the year named is obviously wrong. Even the spelling of names of men of international reputation is found to be seriously in error, as, for example, W. F. Hillebrand is at several points referred to as "Hildebrande." This seems all the more inexcusable because the photographic reproduc-



tion of Lord Ramsay's original note-book record spells the name correctly.

It is very unfortunate that these inaccuracies (which a careful reading of the proofs should have disclosed) should detract from the apparent dependability of much of the text. It is also unfortunate that the book is most inadequately assembled and bound, an extremely poor example of modern book binding. But despite its mechanical and textual errors, the book is one well worth while and a stimulating addition to the literature recording the history of research.

\* \* \* \*

### Mineral Raw Materials

MINERAL RAW MATERIALS. By J. W. Furness, U. S. Bureau of Foreign and Domestic Commerce, L. M. Jones, U. S. Bureau of Mines, and F. H. Blumenthal, Washington, D. C.: United States Government Printing Office. 278 pages. Free on application.

Reviewed by HOMAR L. JOHNSON

THOUGH issued under the unpretentious heading of Pamphlet No. 76, Department of Commerce Trade Promotion Series, this compact little publication is sure to win for itself an honored position, or at least a place of frequent reference, on the bookshelves of any individual or organization concerned with minerals. Essentially a statistical compilation, the authors succeed in presenting their subject-matter in an easy-to-read style that should prove of material assistance in overcoming the common distaste for statistics in any form.

In large part this work consists of a statistical study of world commerce in various minerals during the five-year period 1923-27. Specific estimates of ore reserves and mineral resources available for future consumption are given occasionally throughout the book, though the authors find it necessary to confine themselves mostly to generalized statements in this direction. A short introduction is followed by four pages of charts, portraying graphically the commercial position with respect to mineral raw materials of the principal nations and mineral-consuming countries. Part I of the text constitutes a survey of mineral production by countries; Part II, a survey of production by minerals. Excellent judgment has been shown in the arrangement of the subjects covered by these two surveys, so that the seeker after information on a definite topic may arrive at his "destination" with a minimum of wasted effort. Further graphic and tabular studies of the relative positions of the various important mineral-producing and consuming countries serve as summaries, which may be considered as arriving at the obvious conclusions indicated by the text.

\* \* \* \*

### Paper Manufacture

THE MANUFACTURE OF PULP AND PAPER, Vol. V, Second Edition. J. N. Stephenson, Editor. McGraw-Hill Book Company, Inc., New York. 732 pages. Price, \$6.

AS COMPANION volume to the fourth this work completes the revision of the section on paper manufacture proper, made necessary by both the intervening strides of the industry and its receptiveness to this important undertaking.

The reapportionment of material now finds Volume V to comprise Paper-Making Machines; Hand-Made Papers and Tub Sizing; Paper Finishing; Coated Papers; Paper Testing; and Paper-Making Details. Some of the

chapters have been extensively rewritten; many new subjects—e.g., hydrogen-ion concentration and the use of steam—have been added. Again the work is the product of the distinguished group of technologists that gave the previous volumes their authoritativeness.

To those for whom the textbook is not of uniform interest in its entirety it may be urged that the last two volumes are complementary in scope; taken together they form an entity covering the practical side of paper-making procedure.

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### Behavior of Organic Compounds to Heat

THE PYROLYSIS OF CARBON COMPOUNDS. By Charles Dewitt Hurd. Chemical Catalog Company, New York, 1929. 895 pages. Price, \$12.50.

Reviewed by BENJAMIN T. BROOKS

ON PICKING up this volume by Dr. Hurd one has visions of the articles in the early volumes of *Annalen* or the brief articles in the *Comptes rendus* which described the general results of passing something through a "hot" or a "red hot" tube. But discussion of such early work is the least of the subjects critically reviewed by the author.

Dr. Hurd has culled his material from the whole of organic chemistry and far from offering a heterogeneous catalog of observations having little relation to each other, the author has brought his material together under a series of "generalizations" which are discussed in the second chapter. Accordingly, one reads the following pages with the idea of better understanding the mechanism of organic reactions, the "electron attraction of radicals," the sometimes curious effect of structure on stability and behavior which makes organic chemistry, for those who love it, the most fascinating subject in the world.

Dr. Hurd has used a large canvas. A glance at the author index indicates that well over three thousand references to the original literature are given. It is also gratifying to note that while the treatment of the subject is generally along theoretical or fundamental lines, the author has not refrained from including many matters dealing with industrial processes. At a time when the recent rapid development of high-temperature cracking, or "pyrolysis," of petroleum has made available tremendous quantities of ethylene, propylene, butenes, pentenes, etc., now generally valued at their fuel value, such a comprehensive review as Dr. Hurd's "Pyrolysis" is particularly welcome. The reviewer hails with delight the frequent use of the conception of free radicals and the boldness with which the author has exercised his editorial prerogative in criticizing or interpreting the work of others, which is perhaps the best excuse for writing a scientific book.

In connection with the chapter on the "Aliphatic Hydrocarbons" one recalls that the pyrolysis of methane and the simpler paraffins is being actively investigated at the present time in industrial laboratories, that only within a year or so has the cracking of petroleum oils for gasoline shifted strongly toward high temperatures, in many cases to so-called vapor-phase operation for the purpose of obtaining gasoline of high anti-knock value. Throughout the book frequent references are made to the effect of heat in causing polymerization.

Another chapter deals with "Petroleum, Rubber and Related Hydrocarbons." The destructive distillation of

wood and coal is discussed rather briefly in view of the many special works dealing with the subject.

The number of useful preparative methods based on pyrolysis, of course, is very large, and that the general method is far from being crude and obsolete is evident from the author's account of the catalytic decomposition of alcohols, the preparation of ketenes, the recent preparation by Ruzicka of cyclic ketones having ten to eighteen carbon atoms in the ring, and the work of von Braun on the decomposition of quarternary ammonium hydroxides. In the chapters on "Amines," "Amides," "Anilides," "Hydrazides," "Cyanides" and "Hydrazines and Related Substances" there is a wealth of material dating back to the days of A. W. Hofmann and Ladenburg to the more recent work of Curtius, von Braun, Staudinger, Wieland and others.

The work of Dr. Hurd is distinctly a contribution to the literature of organic chemistry, not merely a review.

\* \* \* \*

### Decolorizing Agents

ANORGANISCHE UND ORGANISCHE ENTFÄRBUNGSMITTEL. By Leopold Singer. Theodor Steinkopff, Dresden, Germany, 1929. 251 pages. Price 21.50 M.

Reviewed by PAUL MAHLER

THE value of Dr. Leopold Singer's book lies in its compilation of probably most of the available references pertaining to inorganic and organic decolorizing agents. It covers information on the occurrences, properties, the various methods of manufacture and activation, the principles underlying the different decolorizing methods and the various uses of this class of materials.

In view of the ever-increasing number of uses of decolorizing agents this book should serve as a valuable aid to the few investigators who are concerned with the study of these materials. Those, however, who may be interested in the subject of purification of the many different chemical products which are amenable to a treatment with absorbent agents (and their number is continually increasing) would soon tire perusing this work.

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### Handbook for Gas Chemists

GAS CHEMISTS HANDBOOK. Prepared under direction of a special chemical sub-committee, A. F. Kunberger, Chairman. Published by American Gas Association, 1929. 795 pages. \$7.

THIS third edition brings up to date the recognized standard methods for the testing of raw materials and products of gas manufacture, for the detection and determination of impurities in gas, and for the many miscellaneous materials tests common about coke and gas works. The volume has had a thorough overhauling and a critical study by the editorial committee, assisted by many of the best men in the industry. The result is a set of procedures and recommendations which are worthy of attention by all those who find occasion to do work of the character covered. Industrial users of gas who may, because of isolated location, operate plants of their own, will do well to have their control laboratory thoroughly acquainted with the methods described. Since the methods have received such careful and critical review the results obtained with them are generally acceptable and should be particularly advantageous in any cases of controversy over contracts for supply of the commodities for which tests are given.

### Occupational Study at Yale

THE CHOICE OF AN OCCUPATION. Department of Personnel Study, Yale University, New Haven, Conn. 227 pages.

AVOWEDLY published in the interest of Yale students, this study nevertheless represents a really definite achievement in the general grapple with the occupational and, incidentally, educational problem. Modest in attitude as well as in aspiration it offers a series of brief articles on numerous leading professions, designed to equip the student to choose for himself. It realizes that this choice in itself is not normally difficult; that the mystery, rather, arises when the candidate is confronted by his own defective notions on the alternatives he faces.

Chemical engineering is accorded a brief but balanced treatment: a due regard is given to both its significant and portentous growth and its call upon individual ingenuity and foresight. The pithy survey offered of its true characteristics is indicative of the general quality and value of the work to schools and progressive educators.

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### Pittsburgh Coal Conference

PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON BITUMINOUS COAL. Held in Pittsburgh, Pa., Nov. 19-24, 1928. Carnegie Institute of Technology, Pittsburgh, Pa., 1929. 987 + 940 pages. Price, \$15.

WHAT this convention has meant to its variegated attendance is suggested by the bulk of the material presented during the "coal" week and now accessible in these two volumes. By the same token the significance of the papers thus collated in printed form should become apparent to those who have had no direct prior contact with the two conferences. To its unpared scope goes the credit for the material's exhaustive value; as a result, the latest products of scientific and industrial minds can here liberally attest to the present status of coal utilization and, what is of equal importance, in the words of the leaders themselves. That anyone active in this wide industrial field should fail to welcome this aggregate of fresh knowledge to his shelves, or at least his eager attention, it would be difficult to imagine.

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### Recently Arrived

ALLEN'S COMMERCIAL ORGANIC ANALYSIS. Volume VII: The Vegetable Alkaloids. 5th Edition. By C. Ainsworth Mitchell F. H. Carr, Oliver Chick, Norman Evers, J. J. Fox, T. A. Henry, P. J. Sageman, T. M. Sharpe, F. O. Taylor, R. W. Tonkin, S. Whymper. P. Blakiston's Sons & Co., Philadelphia, 1929. 868 pages. Price, \$7.50.

A further addition to the new revised edition which has been steadily growing in the past few years. New features are the inclusion within two covers of all vegetable alkaloids, an improved classification of material, and a considerably expanded text.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, TRANSACTIONS, VOL. XXI, 1928. Published by the Institute. D. Van Nostrand Company, Inc., New York, 1929. 144 pages. Price, \$4.—Papers read and discussed at the Niagara Falls meeting, August, 1928.

DARSTELLUNG METALLORGANISCHER VERBINDUNGEN. By Emil Klarmann. Reprinted from *Handbuch der biologischen Arbeitsmethoden*. Urban & Schwarzenberg, Berlin, 1929. 159 pages.—Preparation of organometallic compounds according to typical combinations of the various metals.



# Selections from Recent Literature

**STANDARD VALVES.** Robt. T. Baldwin. *Journal of the American Waterworks Association*, June, pp. 815-9. The valve constructions which have been adopted by the Chlorine Institute as standard for chlorine containers under 15 tons capacity are described and illustrated. One, designed for 100, 105 and 150 lb. containers, has a safety plug and is adapted to both union and clamp fittings. The same design, with larger opening and no safety plug, is standard for ton containers. The specification is quoted in full.

**VACUUM FRACTIONATION.** Arthur A. Ashworth. *Journal of the Institution of Petroleum Technologists*, April, pp. 211-3. The separation of fractions when distilling in vacuo has been limited to very few fractions, or has necessitated the use of separately evacuated duplicate receivers, or has prevented sampling during the distillation. An apparatus has now been devised which permits separation and withdrawal of any number of fractions during the distillation, and employs no duplicate receivers or other devices which add to the load on the vacuum pump. It is also quite convenient to operate. The apparatus is illustrated, and its application to fractionation of lubricants is described.

**ORGANIC HYDROGENATION.** A. A. Balandin. *Zeitschrift für physikalische Chemie*, May, pp. 167-94. In catalytic hydrogenation of organic compounds, using a nickel catalyst, there is a quite definite arrangement of atomic groups containing carbon, hydrogen, nitrogen, oxygen and halogens, according to the ease with which they are split off by hydrogen from the parent compound. A theory is developed to explain the influences governing this series, and it is shown that the same principles are valid in other catalytic processes using nickel—e.g. dehydrogenation, saturation of double bonds, dehydration of alcohols, and in several condensation reactions.

**SOLVENT RECOVERY.** L. Piatti. *Chemische Apparatur*, May 25, pp. 105-7. Difficulties due to partial condensation, sometimes encountered in solvent recovery installations, are caused by faulty design of the apparatus with respect to the relative specific gravities of air and the solvent vapor. Generally the fault lies in the practice of removing the air-vapor mixture by upward motion. Since solvent vapors are heavier than air, the air-vapor mixture also is heavier at the same temperature and pressure. To make it lighter, it must be warmer than the outside air, in proportion to the concentration of solvent vapor. But the necessary temperature gradient may cause condensation when the air-vapor mixture

reaches the cooler parts of the apparatus. Methods of proper operation are suggested.

**ERKENSATOR.** B. Kolb. *Chemische Apparatur*, May 25, pp. 107-8. The Erkensator is a centrifugal apparatus for clarifying liquids from suspended substances of low specific gravity, or for dewatering light materials. The machine is described and illustrated, and its application to the purification of half-stuff in making paper pulp is described and advantages are stated. Power consumption is about 3.5 to 3.8 hp. for the empty machine, and 4.5 to 5 hp. under load. There are numerous possible applications of this machine in chemical technology.

**COMPRESSED AIR.** Max Berger. *Apparatebau*, May 31, pp. 121-2. It is not practicable to free compressed air from its entrained oil, water and dust immediately after it leaves the compressor or the storage tank. The proper place for purification is after the air has traversed a portion of the pipe through which it is to pass, and has been sufficiently cooled. The Ibach cleaner attachment has been designed for this purpose. It filters the air first over sharp-edged metal turnings, then through fine wire gauzes and finally through a rotary sieve. It delivers clean, dry air and will hold about 24 hours' accumulation of dirty oil and water, which can be drawn off at the bottom.

**VISCOSE CENTRIFUGING.** E. M. Noble. *Canadian Chemistry and Metallurgy*, June, pp. 165-6. The super-centrifuge is useful in several ways in the manufacture of viscose and viscose silk. First, it gives an inexpensive means of purifying the spent caustic and of recovering it for reuse. The dissolved hemi-celluloses must be precipitated before centrifuging. A more important application is in clarifying the viscose solution during the aging period. This is preferably done twice, after 24 and after 48 hours of aging. The final clarification after the third aging period is done in a filter press, because bubbles left after centrifuging would be harmful in the spinning process. Finally, a battery of centrifuges, operated on a continuous bypass system, can be effectively used for clarifying the acid fixing bath.

**DIAPHRAGMS.** Heinrich Pincass. *Chemiker-Zeitung*, June 5, pp. 437-8. In diaphragms for electrolytic processes, such as the production of hydrogen, the early use of asbestos gave way first to the Pechkranz nickel diaphragm, then to steel (Bamag), which could be made even more porous than the nickel. Cement also has been tried, but is little or no better than

asbestos. Regenerated cellulose, glass wool and porous hard rubber also have been used. Of all these, the Wilderman hard rubber diaphragm is given the preference. It can be made in any desired shape and thickness, with metal reinforcement if needed. Its use in Billiter cells is described. This type of diaphragm is suitable for separator sheets in storage batteries, as well as for electrolytic processes.

**PIPE CORROSION.** F. Besig. *Korrosion und Metallschutz*, May, pp. 99-110. Pipe corrosion is classified as chemical and electrochemical. Chemical attack is from outside (soil corrosion) or from inside. Electrochemical corrosion is caused by stray currents from near-by power or trolley lines or the like, or by currents set up by galvanic elements between the pipe and the soil. Preventive measures, classified according to the cause of corrosion, are discussed. They include avoiding acid slag in making the pipe; preventing access of air and moisture; freeing the material to be pipe from corrosive impurities; guarding against stray currents and galvanic currents in the pipe; application of metallic or non-metallic protective coatings; and electrolytic methods of protection.

**TAR SCRUBBER.** Otto Krebs. *Teer und Bitumen*, June 1, pp. 273-7. A continuous scrubber apparatus has been developed for the specific purpose of extracting alcohol-soluble matter from lignite tar. The product of the extraction yields Fresol, a technically useful distillate of sufficient value to cover all the overhead costs of the tar purification treatment. The system includes, after the scrubbing column, a heat exchanger, an oil purification column, an alcohol rectifier, a dephlegmator, a condenser, and a purifying column for the extract. The alcohol consumption is small and the products recovered include, in addition to Fresol, a light oil distillate.

**WATER STILL.** *Chemical Trade Journal*, May 31, p. 523. The "Christ" multi-stage water still is a column system evaporator which lowers the fuel cost for distilling water to such an extent as to increase greatly the availability of distilled water for chemical and pharmaceutical processes, electrical uses and for manufacture and use of storage batteries. The spent steam is utilized in the evaporators, by properly selected temperature and pressure gradations, until its heat content has been efficiently recovered. The circulation of warm cooling water over the evaporators is automatically controlled. The apparatus is shown in a photograph.

**TUBE STILL.** Luis de Florez. *National Petroleum News*, April 23, pp. 75-80. The de Florez vertical tube still is adaptable for either down-shot or up-shot firing, according to the intended use. The essential structural features are a radiant section (comprising a vertical cylindrical shell lined with vertical

tubes) and an economizer section, which may be a tube still or (for some uses) an air heater replacing the tube bank. A mechanical forced-draft oil and gas burner concentrates the flame toward the center of the cylinder. The tubes usually are connected in series for single flow, but can be divided for multiple flow if desired. The large absorbing surface in the vertical section provides rapid absorption of heat, so that the combustion gases escaping to the economizer are cooled to 1200-1400 deg. F., and the volume requirement for combustion is so reduced that 15,000 to 16,000 B.t.u. per hour per cubic foot can be liberated over long periods of time. In the conventional pipe still the average limit probably is about 6,000 B.t.u. per hour per cubic foot, over 8,000 being seldom possible. As used in vapor-phase oil cracking (de Florez process), this still develops 70 per cent efficiency and has long performance life because the heat exposure of the insulating brick is not extreme. Another advantage for oil heating, which involves higher tube temperatures than in steam practice, is that excess air (free oxygen) in the combustion gases can be kept to a minimum, so that there is very little deterioration of tubes due to oxidation.

### Government Publications

*Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.*

Commercial and Industrial Organizations of the United States, Revised Edition, 1929. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series 5. 60 cents.

Mineral Raw Materials—Survey of Commerce and Sources in Major Industrial Countries, by J. W. Furness and associates. Bureau of Foreign and Domestic Commerce Trade Promotion Series 76. 45 cents. A monumental compendium of production and international trade in metals and minerals of interest to American industries.

Free and Dutiable Imports of the United States in the Calendar Year 1927. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 626. 10 cents.

Effect of Repeated Daily Exposure of Several Hours to Small Amounts of Automobile Exhaust Gas, by R. R. Sayers and others. U. S. Public Health Service Bulletin 186. 15 cents. Significant for plant exposures of workmen to carbon monoxide.

Good Naval-Stores Practice, by Austin Cary. U. S. Department of Agriculture Leaflet 41.

Foreign Trade Reports. Mimeographed Special Circulars of the Chemical Division, Bureau of Foreign and Domestic Commerce as follows: No.

276, The Fertilizer Trade of South Africa, by E. B. Lawson; No. 273, Sulphur and Sulphuric Acid Market in Mexico, by George Wythe; No. 275, Prospects of New German Nitrogen Plants, by William T. Daugherty; and No. 279, International Lead Oxide Convention, by Homer S. Fox.

Wood Products Reports, issued by the Bureau of the Census giving Census of Manufactures figures for 1927 as follows: Wood Distillation and Charcoal Manufacture, printed pamphlet, 5 cents; Turpentine and Rosin, printed pamphlet, 5 cents; and Pulpwood Consumption and Wood-Pulp Production, Production of Paper and Paper Boards, and Paper-Making Equipment in Use, 1928, preliminary mimeographed statistics.

Survey of Cracking Plants, Jan. 1, 1929, by G. R. Hopkins. Bureau of Mines Information Circular 6127. A directory of the industry.

The Free Energy of Water, Carbon Monoxide, and Carbon Dioxide, by E. D. Eastman. Bureau of Mines Information Circular 6125.

Consumption of Reagents Used in Flotation, 1927, by A. M. Gaudin. Bureau of Mines Serial 2931.

Strontium from a Domestic Standpoint, by R. M. Santmyers. Bureau of Mines Economic Paper 4. 5 cents.

Mineral production statistics for 1928—preliminary mimeographed statements from Bureau of Mines on: Manganese, asbestos, graphite, natural sodium compounds, asphalt, magnesium, and feldspar.

Mineral production statistics for 1927—separate pamphlets from Bureau of Mines on: Zinc, by E. W. Pherson, 5 cents; Secondary Metals, by J. P. Dunlop, 5 cents; Rare Metals—Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium, by Frank L. Hess, 10 cents; Petroleum, by G. R. Hopkins and A. B. Coons, 15 cents; and Coal, by F. G. Tryon and others, 30 cents.

Fuel Briquets in 1928, by O. E. Kiessling and J. M. Corse. Bureau of Mines Mineral Resources Pamphlet, 5 cents.

Textile Materials Specifications, issued by the Bureau of Standards as Federal Specifications Board Specification 345a. A general document relating to physical and chemical testing of all types of textile materials.

Brush Specifications. Twenty-four specifications for various types of brushes have recently been revised and issued in mimeographed form by the U. S. Government Specifications Board, of the Bureau of Standards. Those interested in any type of brush specifications will probably find it in these documents.

Geophysical Abstracts, No. 1, by Frederick W. Lee. Bureau of Mines Information Circular 6120. First of a series of papers which will contain abstracts of current articles and publications dealing with applied geophysics. Mimeographed.

### Miscellaneous Publications

GAS CYLINDER RESEARCH—Three reports issued by the British Gas Cylinders Research Committee. Published under the Authority of His Majesty's Stationery Office, 1929. Obtainable in this country through The British Library of Information, French Buildings, 5 East 45th Street, New York. (1) Ordinary Commercial Cylinders for the "Permanent" Gases, Summary of Recommendations (Revised). Revised and republished issue of the Summary of Recommendations which were contained in the First Report of the Committee, now out of print. 4d. net. (2) Alloy Steel Light Cylinders. Third Report of the Committee. 2s. 6d. net. (3) Cylinders for Liquefiable Gases. Fourth Report of the Committee. 4s. net. These documents afford a very complete research report on the metallurgical, pressure-testing, corrosion, and other problems involved in the manufacture and commercial maintenance of high-pressure gas cylinders.

"FLOTATION FUNDAMENTALS" is the general title of a series of technical papers being issued by A. M. Gaudin and associates, who work under the joint jurisdiction of the U. S. Bureau of Mines and the Utah Engineering Experiment Station. The first three of this series, already available, give a number of reports of chemical engineering interest because they relate to the studies on important chemicals used in flotation work. They are available from the University of Utah.

CEMENT RESEARCH REPORT. Report of the Director of Research of the Portland Cement Association for the year ending November, 1928. Issued by the Association, 33 West Grand Avenue, Chicago.—Includes, in addition to the administrative and general report, the history of the research activities of the general administration and five technical papers.

TRANSPORTATION OF EXPLOSIVES AND CHEMICALS. Report of the Chief Inspector of the Bureau of Explosives, American Railway Association. Issued by the Association, 30 Vesey Street, New York City.—Summarizes technical information obtained through investigation of all transportation accidents involving chemicals during 1928.

ZINC WORKERS' MANUAL. Published by The American Zinc Institute, Inc., 27 Cedar St., New York. 112 pages. Uses and applications described, with illustrations and appendix of tabular data.

SAFETY IN CHEMICAL ENGINEERING. Chemical Section, National Safety Council, 168 North Michigan Ave., Chicago. Cumulative Data Sheets on plant procedure, such as "Handling Caustic Soda," "Design and Operation of Centrifugal Extractors," etc.; also series of Safe Practice Sheets on different poisons such as "Carbon Monoxide," "Nitrous Fumes," "Chromium," "Perchlorates," and the like.



# THE PLANT NOTEBOOK

## *an exchange for OPERATING MEN*

### Simplified Welding of Aluminum Castings

IN THE welding of aluminum castings, it is usually recommended that the piece be carefully supported in the preheating furnace and preheated very slowly preparatory to the actual welding. Experienced aluminum welders, however, frequently dispense with this procedure and handle even complicated jobs entirely with local preheating, using an oil burner for the purpose.

An actual instance, shown in the illustration, was the case of an aluminum casting 56 in. in diameter and  $\frac{3}{4}$  in. thick, the lid of a rotary bottling machine, cracked from one edge about 20 in. toward the center. The circular shape of the casting made the expansion



Break in Aluminum Casting Under Repair by Welding Torch and Preheater

problem fairly easy, although it was complicated somewhat by a manhole opening at one edge, through which the crack passed, and varying thickness of the metal. The lid had a crown of about 3 in., which increased the difficulty of penetrating the full thickness without forming projections of metal on the inside. This was to be avoided, as it would necessitate extensive finishing.

Preheating the entire casting was deemed unnecessary, so that the procedure employed was as follows: A steel plate was formed to fit the inside of the lid, and clamped to it along the crack. With the casting firmly secured and aligned, the whole length of the break was heated slightly with an oil burner. Welding was then started at the inner end of the break, with the preheater heating the aluminum thoroughly a few inches ahead, to open up the crack to the expansion limit, and a puddling rod and cast aluminum flux insured a sound weld. As sections of the break were finished a covering of asbestos paper was put on, and all during the work great care was taken to keep drafts and cool air from the work. With these precautions the welding went ahead

quite smoothly; in fact, the whole 40-in. break was completed in about an hour and a half and the job required little finishing.

### Useful Tube Table

By L. C. COOLEY  
Engineer, Swenson Evaporator Co.,  
Harvey, Ill.

IT WILL frequently happen that the plant man must design a heater or a condenser for a given amount of surface. When he has calculated the amount of surface and hence the number of tubes, the question of the diameter of the tube bundle comes up. The accompanying table gives a simple answer to this. With an assumed distance between tube centers, the diagonal of the tube bundle may immediately be calculated from the number of rows.

Tube Table—Hexagonal Arrangement

No. of Rows	No. Tbs. In Hexgnl. Area	No. of Rows	No. Tbs. In Hexgnl. Area	No. of Rows	No. Tbs. In Hexgnl. Area
1	7	18	1027	35	3781
2	19	19	1141	36	3997
3	37	20	1261	37	4219
4	61	21	1387	38	4447
5	91	22	1519	39	4681
6	127	23	1657	40	4921
7	169	24	1801	41	5167
8	217	25	1951	42	5419
9	271	26	2107	43	5677
10	331	27	2269	44	5941
11	397	28	2437	45	6211
12	469	29	2611	46	6487
13	547	30	2791	47	6769
14	631	31	2977	48	7057
15	721	32	3169	49	7351
16	817	33	3367	50	7651
17	919	34	3511		

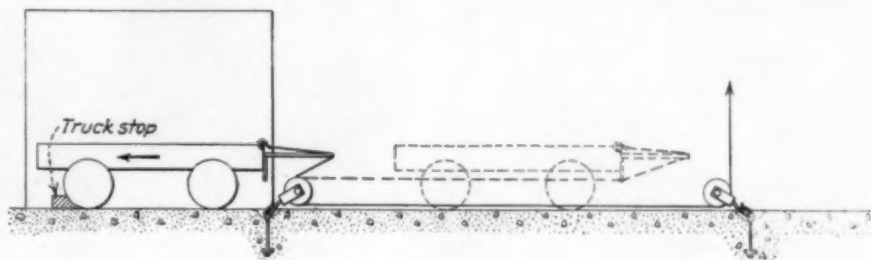
### Hauling Cars Into Ovens

By T. M. NAMIKY  
Tokyo, Japan

METHODS normally used in hauling trucks in and out of firing or drying ovens often carry the disadvantage of expense or inconvenience due to obstruction of the plant floor. When in the vicinity of a crane, however, a simple arrangement will suffice to accomplish the hauling very satisfactorily.

The accompanying drawing shows the arrangement that has been employed for

Routine Haulage of Cars Adapted to Existing Facilities



hauling the cars into ovens. The omission of one pulley obviously would take care of the reversed procedure, hauling them out. It will be noticed that, by agency of its horizontal mast, the car will recede further into the oven than would otherwise be possible. Of course, the system is subject to any modifications that the immediate situation makes feasible.

### Line-Start Motors Require Larger Drive Areas

By J. R. HOSKINS  
Chicago Belting Company  
Chicago, Ill.

IT HAS been computed that, with 15 per cent of all new motors of the line-start type at the present time, the percentage is apt to rise to close to 70 per cent in about five years. Any details in their application, of great importance already, would be greatly emphasized by the prospective expansion in their use.

Of the two varieties made, normal load and high torque, both have a comparatively high starting overload, a fact which has significant bearing on the in this respect that we still meet with a serious shortcoming. Standards of pulley and belting widths have been transferred from the old type to the new without regard for the altered circumstances. As a result, numerous instances have been reported of burned belts and stripped chain belts.

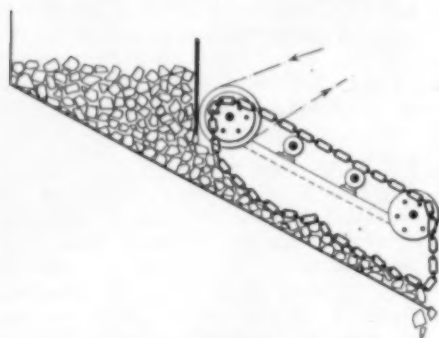
On the basis of a 150 per cent starting overload, as compared with 112 per cent in the normal motor, a normal load line-start motor should have a pulley and belt 20 to 25 per cent wider for motors over 7½ hp. In the case of a high torque type, however, it is advisable to make this increase 50 per cent for all motors over 10 hp. These figures will vary slightly for each specific case; but since deliveries normally are made with the old widths it will prove profitable to every user to make an immediate check and to have the width regulated accordingly. In older motors, the two alternatives of greater pulley diameters and greater width often combine to offer the best expedient under the conditions.

# EQUIPMENT NEWS

*from MAKER and USER*

## Chain Feeder

ONE of the difficulties in discharging lump material from bins by means of chutes is the inaccuracy in the control of the operation. To circumvent this trouble the Ross Feeder was developed in England and has now been placed on the American market by the Ross Screen & Feeder Company, 247 Park Avenue, New York, N. Y. This feeder makes it possible to use a large chute



Ross Chain Feed in Chute

opening and at the same time to control the flow of feed very closely.

The feeder consists of a curtain of heavy, endless steel chains driven by an overhead tumbler and suspended in front of the chute opening so as to lie on the material and to travel with it. The accompanying sketch illustrates how this is accomplished. It will be noted that the heavy chains, which fill the entire width of the chute, lie upon the discharging material for a considerable distance. The accuracy of control is said to be within 2 per cent on a tonnage basis. Several other variations of the principle have been worked out wherein the feeder may be used in connection with chutes of variable angle, chutes which are equipped with grizzly bars for screening out the fines, and so on.

## New Facing Metal

TWO new alloys have recently been introduced by the Commercial Alloys Corporation, San Francisco, Calif., to be marketed under the name of Cristite Series 1 and Cristite Series 3. The first alloy has a hardness of 61 to 67 and the second a hardness of 49 to 55 on the Rockwell C Scale. Both alloys are applied as a surfacing by flowing onto the surface to be protected with ordinary welding equipment. They are supplied in the form of welding rods. Either may be used for surfacing the hammers of crushing and grinding equipment although the series 3 alloy

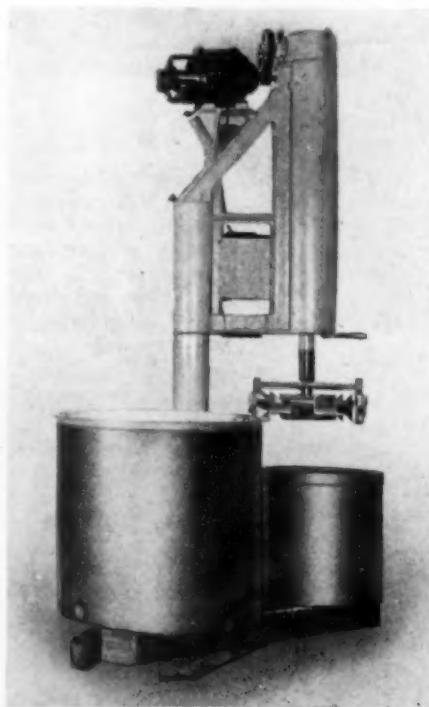
is said to withstand impact much better than series 1.

The alloys are made from magnetite which is passed first through a magnetic separator and is then roasted and reduced. This is accomplished by mixing the magnetite with tungsten ore, gas coke and hot molasses. The mix is formed into rods and baked, after which it is used in the form of electrodes in a three-phase alternating-current furnace in parallel with three graphite electrodes.

When this furnace reduction has taken place the charge is refined in a refining furnace, after which it is poured into molds and delivered as the finished product, welding rods. In application, the alloys are said to show a good penetration into the metal surface and to result in greatly increased life of grinding equipment.

## New Turbo Mixer

FOR YEARS the paint and enamel industry has employed change cans mounted upon trucks for the mixing of materials. To serve this market as well as others in the process industries where batch mixing can conveniently be handled in this type of equipment, the Turbo-Mixer Corporation, 233 Broadway, New York, N. Y., has developed a self-contained unit for change-can and



New Change-Can Turbo-Mixer

portable-tank work. It consists of a central post upon which is mounted a turbo-mixing unit directly driven by a motor and gear, the whole of which swings on a radius of about  $3\frac{1}{2}$  ft. above the central post. Thus three cans of material to be mixed may be grouped upon the central post and the mixer lowered into each one in succession. Lowering is accomplished by rotating a crank placed in the side of the mechanism.

The mixing unit consists of a turbine-type impeller rotating within a ring of deflecting blades. The purpose of this ring is to prevent tangential motion of the liquid being mixed. Instead the motion is radial, the liquid passing outward from the impeller and being deflected upward and downward by the sides of the can.

Advantages claimed for the new mixer include ease of cleaning, ease of changing cans and very rapid mixing. This mixer is said to be especially adapted to the handling of extremely viscous materials.

## Dust-Tight Starter

The development of dust-tight inclosing cases for their across-the-line automatic starters has been announced by Cutler-Hammer, Inc., Milwaukee, Wis. The inclosure is built of cast iron for motors up to 5 hp. and boiler plate for larger sizes. It is provided with soft rubber gaskets and closed by eyebolts and wing nuts.

## High-Velocity Evaporator

DEPARTING from standard practice in climbing-film evaporators, the Struthers-Wells Company, Warren, Pa., has introduced a new machine known as the I H V evaporator. The evaporator is of the inclined-tube type but omits the usual large vapor space, relying upon a new design of entrainment separator to produce a dry vapor.

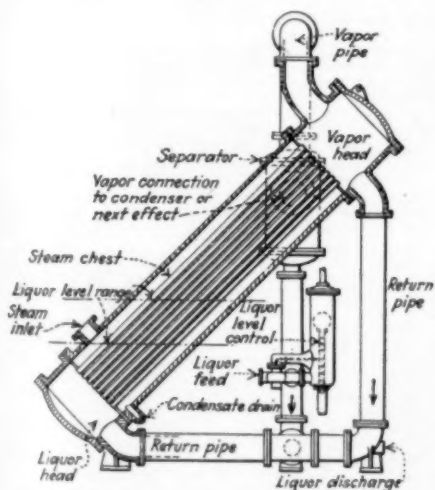
The accompanying drawing shows that the evaporator consists of an inclined tube bundle surrounded by a steam chest. Liquor standing in the lower portion of the tubes is caused to climb rapidly, due to the expansion of the steam given off, and strikes against the top head at high velocity. The vapor, with still a considerable amount of entrainment, leaves the vapor head through the upper opening and passes downward into the separator, flowing then from the separator back to the circulating system. Liquor which is thrown downward at the vapor head returns to the evaporator. A portion is continu-



ously withdrawn as the finished product.

If desired, the evaporator may be supplied with an automatic feed valve to maintain the desired level. This is placed in the return line from the separator to the circulating system. The separator is said to be one of the principal features of the machine and employs the principle of parallel-flow separation. Instead of effecting separation of the liquid by reducing the velocity of the vapor, the separator used here causes the vapor to change direction at high velocity, after which it is split into two streams which are caused to flow around several specially shaped baffles. The separated entrainment returns to the circulating system and the vapor, said to be exceptionally dry, continues to the condenser or the steam chest of the next effect. It should be noted here that the evaporator is adapted for use either in single or multiple effect.

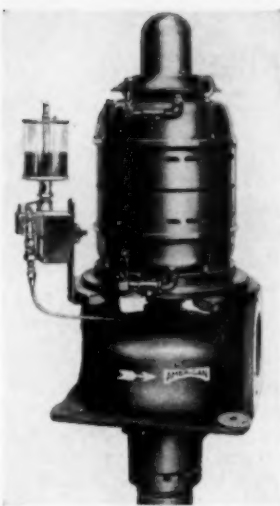
While the evaporator is said to be applicable for all uses except where there is salting out, one of its most important fields is claimed to be in connection with liquids which foam badly. The violence with which the liquid is thrown from the tubes against the vapor head is credited with doing away with foaming completely. In addition, the claim is made that increase in capacity, within the evaporating ability of the machine, actually increases the efficiency of entrainment separation.



New I H V Evaporator Has No Large Vapor Space for Entrainment Separation

## Deep Well Pump

A new development announced by the American Well Works, Aurora, Ill., is a turbine pump intended for smaller-bore wells. This is made in the 6- and 8-in. size and consists of the turbine head proper, the supporting pipe which incloses the driving shaft and the turbine itself. The latter is made in any number of stages necessary for the specific requirements. The turbine head consists of a vertical motor mounted on a rigid and compact base. The thrust bearing of the motor is designed to carry the load of the driveshaft and



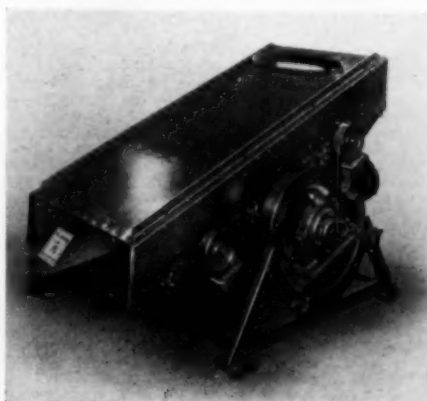
New American Well Works Turbine Pump Drive

impellers. The head carries the supporting pipe, at the lower end of which is attached the turbine.

## "Jigger" Screen

A VIBRATING screen of the eccentric throw type which possesses several features of novelty is being marketed under the name of the "Jigger" screen by the Productive Equipment Corporation, 7535 South Claremont Ave., Chicago, Ill. The screen body is mounted upon rubber disks which are in turn secured to a tiltable framework, as shown in the illustration. The framework pivots about a shaft which runs beneath the frame and which carries the eccentrics and two heavy flywheels. The flywheels confine the vibration to the screen itself, while the eccentrics cause the vibration. The eccentricity of the latter is variable at will, depending upon the type of service required. This is accomplished by rotating the eccentric upon the drive shaft, which is itself eccentric.

The adjustment of the incline can be made without tools. Degree angles marked upon the adjusting quadrant permit recording of the most suitable angle for every case. Another feature of the screen is the ease with which the cloth may be changed.

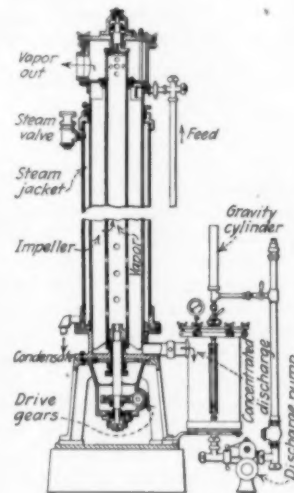


"Jigger" Vibrating Screen

## Intensive Concentrator

THE Zahm & Nagle Company, Inc., 74 Jewett Ave., Buffalo, N. Y., is building a high-capacity concentrator which has previously been used in certain of the food industries but now is being adapted for the first time for use on chemicals. The accompanying drawing shows the evaporator in cross-section. It consists of a vertical steam-jacketed cylinder in which a four-bladed impeller rotates at a peripheral speed of about 1,500 ft. per minute. The liquor to be concentrated is fed in at the top and is caused by the impeller to take a long spiral path in descending the walls of the heating chamber. Centrifugal force is said to reduce priming and foaming to the minimum. Vapor enters the central tube and passes from the top of the apparatus to the steam space of the next effect or to the condenser while the concentrated liquor flows from the bottom into a receiver and then to the discharge pump.

As the time of passage through the evaporator is very short and as the machine may be operated under vacuum, it is recommended by the manufacturer particularly for materials which may be easily injured by heat. The evaporating capacity is about 2,500 lb. of water per hour.



Zahm Concentrator for Materials That Foam

## Electrical Devices

TWO new devices have been announced by the General Electric Company, Schenectady, N. Y., one a compensator designed for use in gaseous atmospheres and the other a new switch which does the work of three devices. The compensator bears the designation CR-1034-N-52. It is of the hand-starting type and is equipped with an oil-immersed starting switch, a standard time-delay undervoltage attachment and dashpot relays used with Cooper Hewitt mercury tubes substituted for the usual contact tips of the dashpot relays. The result of this arrangement is said to be the elimination of exposed sparking or arcing at the contacts.

The new switch is known as CR-7006-

F-1. It combines the functions of magnetic switch, motor circuit switch and inclosed fuses. A principal feature is the ease with which disabled switch mechanisms may be replaced with spare parts carried in stock. Replacement is said to be accomplished with complete safety to the repair man. The switch is intended for the control of any motor with which a general-purpose magnetic switch can be used.

## Optical Pyrometer

An interesting new optical pyrometer for rough work has been developed by Viozone, Ltd., 19 Cursitor Street, London, E.C.4, England. This little instrument is known as the "Pyroversum" and looks somewhat like a slide rule. It consists of a frame calibrated in degrees Centigrade and a center section of shaded glass graduated from clear to opaque. A slider travels over the shaded glass strip and carries a sight, through which any incandescent body may be viewed. The sight is moved until the body can no longer be seen through the shaded glass, whereupon the temperature is read on the scale.

The instrument is recommended for temperatures from 500 to 1,400 deg. C. and is said to be of considerable accuracy for measuring the temperature of kilns, furnaces and molten materials.

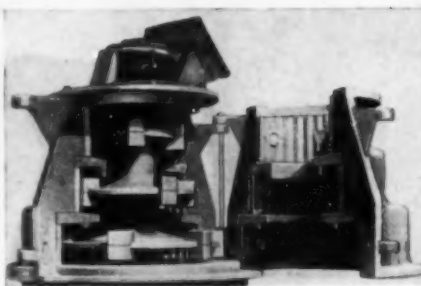
## Light Car Unloader

A new light car unloader for use with hopper-bottomed cars of coke and coal is announced by the Barber-Greene Company, Aurora, Ill. The feeder attachment, already marketed a few months ago, is now equipped with a power unit and, unloading the rail car from below, it comprises the light car unloader. Its capacity is one ton a minute (as compared with two tons for the large unloader), its thickness over the rails is only 3½ in., and its weight comes to 1,700 lb. The power may be either gas or electricity, a further point of convenience being its balance, which enables one man to raise the end for moving. The steel bottom plates, over which the coal and drag flights travel, are renewable.

## Improved Vertical-Type Pulverizer

SINCE the introduction about a year ago of the "Whirlwind" impact-attrition pulverizer by George F. Pettinos, 1206 Locust St., Philadelphia, Pa., several important improvements have been made in the design.

The improved unit, shown sectionally in the illustration, comprises a vertical step-shaped casing split vertically and embodying three pulverizing chambers of different diameters. The pulverizing element consists of three steel disks mounted on a vertical shaft, each disk having rigidly connected to it pulver-



Sectional View of New Pettinos Pulverizer

izing hammers of chrome nickel alloy. Bolted to the sides of the casing of each stage are circular corrugated side plates and the stages are separated by baffle plates which are corrugated top and bottom. The baffles between the first and second and the second and third stages have annular rings on the bottom side projecting downward. These rings cause the material to pass through the space between the hammers instead of over the top.

The breaker and baffle plates are split vertically, the same as the casing, and with the casing halves mounted on heavy hinges, one at each side, the interior of the grinding section of the machine is readily accessible. Directly below the third stage is a collecting chamber from which the material is discharged by means of a two-blade propeller.

In operation, both impact and attrition grinding action take place and in each stage the material has to reach a given state of pulverization before it is air-floated out to the next stage. A dust collector and feeder are available and can be installed where desired as an integral part of the pulverizer. The unit is made in sizes ranging in capacity from 3,000 to 7,000 lb. of coal an hour.

## Manufacturers' Latest Publications

**Agitation.** The Hill Clutch Machine & Foundry Company, Cleveland, Ohio.—Paper by A. L. Whiteside presented at the convention of the American Pulp and Paper Mill Superintendents Association, on propeller agitation.

**Cores.** The Brown Company, Portland, Maine.—Describes Bermico fiber cores and metal ends for paper mills.

**Electrical Equipment.** Crouse-Hinds Company, Syracuse, N. Y.—Bulletin 2130—"Sunbeams in the Night," booklet on floodlighting.

**Equipment.** General Electric Company, Schenectady, N. Y.—Publications as follows: GEA-81A, industrial heating devices; GEA-214-A helicoil sheath-wire immersion heaters; GEA-1118, two-stage reciprocating air compressors; GEA-1120, reciprocating air compressors, two-stage, stationary; GEA-1119, reciprocating air-compressor sets, single-stage, stationary; GEA-1121, reciprocating air-compressor sets, single-stage, portable; GEA-394A, induction motor-generator sets, ½ to 35 kw.; GEA-1138, type DA-1, DA-2, and DA-3 pillars; GEA-86A, single-phase directional overtime relays; GEA-782A, outdoor station equipment, weatherproof switch houses; GEA-1142, type EW resistors for haulage locomotives; GEA-904B, single-stage centrifugal air-compressors for cupola blowing; GEA-881B, type WD-200A arc welder, Continental gas-engine driven; GEA-994A, travel carriage for automatic arc welders; GEA-874D, type WD-200A, arc welder for belt, motor, or gas-engine drive; GEA-875D, type WD-300A arc

welder for belt, motor, or gas-engine drive; GEA-1125 on GE arc-welding school; GEA-970A, type PQ relays; GEA-1104, motor drive for metal-working machinery; and bulletin on Selsyns for remote signalling, control and indication.

**Equipment.** Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.—Booklet No. B-1579-S on Micarta silent gears and pinions with description, application and data tables.

**Heating.** Connersville Blower Company, Connersville, Ind.—Bulletin 233 on Victor gas boosters.

**Heating.** Parks-Cramer Company, 1102 Old South Bldg., Boston, Mass.—Leaflet on gages and thermometers used in Merrill process of industrial heating by oil circulation.

**Heating.** Niagara Blower Company, 673 Ontario St., Buffalo, N. Y.—Leaflet on gas-fired fan heater.

**Illumination.** Crouse-Hinds Company, Syracuse, N. Y.—Bulletin 2134 on type ADA floodlight.

**Illumination.** Benjamin Electric Mfg. Company, Des Plaines, Ill.—Supplement No. 1 to catalog 24 on additions to manufacturer's line of lighting equipment.

**Instruments.** Bristol Company, Waterbury, Conn.—Bulletin No. 371 on hot blast temperature control.

**Instruments.** Foxboro Company, Foxboro, Mass.—Cumulative leaflets as follows: GC 150A1, recording psychrometer, long-distance type; GC 152A1, recording psychrometer, close-couple type; GC 172A1, water boxes; GC 240A1, recording liquid level gage; GC 242A1, indicating liquid level gage; GC 244A1, air flow liquid level gage; GC 246A1, diaphragm boxes; GC 247A1, liquid level gage accessories; and GC 440A1, planimeter.

**Materials.** Quigley Furnace Specialties Company, Inc., New York City.—Folders on Hytempite in the foundry and power plant, acid-proof cement, refractory gun and corrosion prevention. All illustrated.

**Materials Handling.** Cleveland Electric Tramrail, Wickliffe, Ohio.—Three folders on Cleveland Tramrail conveyors for handling bales and foundry materials.

**Metals.** The International Nickel Company, Inc., 67 Wall St., New York.—Bulletin No. 14 on manufacture of nickel steel plates, and working instructions No. 1 on welding, brazing and soldering Monel metal and pure nickel.

**Power.** American Engineering Company, Philadelphia, Pa.—Illustrated booklet showing new installation at the Detroit Edison Company.

**Power.** Combustion Engineering Corporation, 200 Madison Ave., New York.—Issue No. 17, Vol. 2, of the "Safety Valve," devoted to baffling for straight tube boilers.

**Power.** Schutte & Koerting Company, Philadelphia, Pa.—Bulletin No. 8-C on heavy-duty steam valves, with data and illustrations.

**Pumps.** De Laval Steam Turbine Company, Trenton, N. J.—Leaflet describing new pump and turbine installations at Toronto.

**Pumps.** Goulds Pumps, Inc., Seneca Falls, N. Y.—Cumulative catalog and handbook containing all standard stock types of pumps, together with applications.

**Refractories.** Corundite Refractories, Inc., Massillon, Ohio.—Booklet describing Corundite products and standards adopted by the Refractories Manufacturers Association.

**Safety.** Lincoln Electric Company, Cleveland, Ohio.—Leaflet on the Lincoln cross-line safety service, for motors up to 30 hp.

**Safety.** Mine Safety Appliances Company, Pittsburgh, Pa.—Catalog No. FA1 covering the complete line of first-aid materials.

**Stackers.** Lewis-Shepard Company, 169 Walnut St., Boston, Mass.—Special edition of the "Jacklift and Stacker Practice," descriptive of stacker uses.

**Surfacing.** Parker Rust-proof Company, 2177 East Milwaukee Ave., Detroit, Mich.—Descriptive booklet on Bonderite, a chemical primer for application of paint, enamel or lacquer on iron or steel.

**Surfacing.** Metal Coating Company of America, 497 North Third St., Philadelphia, Pa.—Folder on Metalayer, an apparatus for coating surfaces with metal to any desired thickness.

**Trusses.** Allen Air Appliance Company, 452 Lexington Ave., New York.—Bulletin A50, describing "Triple A" compressors and exhausters for air pressures of ½ to 15 pounds.

**Valves.** Homestead Valve Mfg. Company, Coraopolis, Pa.—Catalog No. 25 on Homestead valves, including types developed since last issue.

**Welding.** A. O. Smith Corporation, Milwaukee, Wis.—Bulletin 505, "The New Way," on Smith-welded oil and gas line pipe, generously illustrated.



# PATENTS ISSUED

## June 4 to June 25, 1929

### Pulp, Paper, Glass, and Soap

Removable-type Fourdrinier Paper-making Machine. Alonzo Aldrich and Earl E. Berry, Beloit, Wis., assignors to Beloit Iron Works.—1,715,528-31.

Manufacture of Soap. Ernst Flammer and Christian Kelber, Heilbronn, Germany.—1,715,999-1,716,000.

Apparatus for Making Plate Glass. Chester E. Henderson, Kokomo, Ind., assignor to Pittsburgh Plate Glass Company.—1,716,312.

Manufacture of Soap. Ernst Flammer and Christian Kelber, Heilbronn, Germany.—1,717,553.

Glass Furnace. Jules J. Quertinmont, Point Marion, Pa.—1,715,568.

Paper-Making Machine. William H. Millsbaugh, Sandusky, Ohio.—1,715,615.

Pulp and Fiber Product and Process of Making Same. Robert A. Marr, Norfolk, Va.—1,717,794-9.

Process and Apparatus for Feeding Glass. William J. Miller, Swissvale Borough, Pa., assignor to Hartford Empire Company, Hartford, Conn.—1,717,802.

Soaps from Sulphonated Mineral-Oil Acid Sludge and Method of Making Same. Orville Ellsworth Cushman and Theodore William Doell, Berkeley, Calif., assignors, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,718,335.

Method and Apparatus for Removing Knots from Mechanical and Chemical Wood Pulp. Axel Christian Andersen and Arne Schie, Borregaard, near Sarpsborg, Norway.—1,718,399.

Paper-Making Method and Machine. William Hulse Millsbaugh, Sandusky, Ohio, assignor to Paper & Textile Machinery Company, Sandusky, Ohio.—1,718,573-4.

### Rubber, Rayon, and Synthetic Plastics

Phthalic-Glyceride Resin and Method of Making Same. Henry C. P. Weber, Edgewood, Pa., assignor to Westinghouse Electric & Manufacturing Company.—1,715,688.

Rubber Composition and Method of Making the Same. Herbert A. Winkelmann, Akron, Ohio, assignor to B. F. Goodrich Company, New York.—1,716,474.

Method for the Treatment of Rubber and Like Substances and the Product Thereof. Arthur Biddle, Trenton, N. J., assignor to United Products Corporation of America.—1,716,478.

Process of Forming a Ketone-Aldehyde Intermediate and Resinous Complex. Carleton Ellis, Montclair, N. J.—1,716,542.

Phenol-Resin Composition. Howard L. Bender, Bloomfield, N. J., assignor to Bakelite Corporation, New York, N. Y.—1,717,600.

Phenolic Resin and Process of Making the Same. George W. Miller, Chicago, Ill., assignor to Bakelite Corporation, New York, N. Y.—1,717,614.

Process of Extracting Acids from Solutions. Herbert E. Martin, Cumberland, Md., assignor to Celanese Corporation of America.—1,717,719.

### Petroleum Refining and Products

Apparatus for the Conversion of Hydrocarbons. Lyman C. Huff, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,716,136.

Apparatus for the Treatment of Mineral Oils. William F. Downs, Chatham, N. J.; Mary Gardner Downs administratrix of said William F. Downs, deceased.—1,716,372.

Submerged Combustion Process. Carleton Ellis, Montclair, N. J., assignor to Ellis-Foster Company.—1,716,433.

Art of Sweetening Hydrocarbon Oils. Max George Paulus, Casper, Wyo., assignor to Standard Oil Company, Whiting, Ind.—1,716,973.

Art of Refining Hydrocarbon Oil. Elmer H. Payne, Wood River, Ill., assignor to Standard Oil Company, Whiting, Ind.—1,716,974.

Process and Apparatus for the Vacuum Distillation of Hydrocarbons. John C. Black, Destrehan, La.—1,717,002.

Art of Manufacturing Paraffin. Clarence A. Ward, Linden, N. J., assignor to Standard Oil Development Company.—1,718,672.

Preparing Hydrocarbon Products. James Simpson, Linden, N. J., assignor to Standard Oil Development Company.—1,718,713.

Process of Treating Tarry Matter, Heavy Hydrocarbon Residues, and the Like. Alexander Stephen Knowles, St. Louis, Mo., assignor to Tar & Petroleum Process Company, Chicago, Ill.—1,717,884.

Method of Refining Petroleum Oil. Roy Cross, Kansas City, Mo., assignor to Cross Development Corporation, Wilmington, Del.—1,718,218.

Apparatus for Oxidizing Hydrocarbon Oils. John C. Black, Destrehan, La., and Wirt D. Rial, Los Angeles County, Calif., assignors to Pan American Petroleum Company, Los Angeles, Calif.—1,718,679.

Process of Purifying Hydrocarbon Oils. Louis Link and Maurice B. Amis, Baton Rouge, La., assignors to Standard Oil Development Company.—1,718,714.

Process for Treating Hydrocarbon Oils. Charles Jason Greenstreet, New York, N. Y., assignor to Gasoline Corporation, New York.—1,718,918.

### Coal and Organic Processes

Organic Phosphate and Process of Making Same. Theodore E. Wagner, Brooklyn, N. Y.—1,716,286.

Process of Producing Water Gas and Extracting Oil From Oil Shale. August Schilling and Richard Sachse, San Francisco, and Dimitri Liamin, Los Angeles, and Theofil Callaert, San Francisco, Calif.—1,716,667.

Gas Manufacture. Walter Edwin Trent, Washington, D. C., assignor to Trent Process Corporation, Washington, D. C.—1,716,673.

Apparatus for the Cooling of Coke. Stewart Roy Illingworth, Brynffedwen, Radr, Wales, assignor to Illingworth Carbonization Company, Limited, Manchester, England.—1,716,727.

Process of and Apparatus for Distilling Wood. Ralph H. Twining, Marquette, Mich., assignor to Cleveland-Cliffs Iron Company, Cleveland, Ohio.—1,716,745.

Purification of Coke-Oven Gases and the Like. Georges Claude, Paris, France, assignor to Société l'Air Liquide, Société Anonyme pour l'Etude et l'Exploitation des Procédés Georges Claude, Paris, France.—1,717,761.

Process for the Manufacture of Casein. William H. Sheffield, Hobart, N. Y.—1,716,799.

Process of Making Unsaturated Aldehyde and the Product Thereof. Angelo Knorr, Berlin, and Albert Weissenborn, Potsdam, Germany, assignors, by mesne assignments, to Winthrop Chemical Company, Inc., New York.—1,716,822.

Process for Purifying Alpha Naphthol. Alex Brooking Davis, Cincinnati, Ohio, assignor to Pennsylvania Coal Products Co., Petrolia, Pa.—1,717,009.

Process of Producing Salts of Carboxylic Acids. Guy H. Buchanan, Westfield, N. J.; George Barsky, New York, N. Y.; and Kenneth D. Ashley, Elizabeth, N. J., assignors to American Cyanamid Company, New York.—1,717,353.

Process of Distilling Solid Carbonaceous Material. Carl Postel, New York, N. Y., assignor to American Shale Reduction Company, New York.—1,717,808.

Apparatus for Manufacturing Water Gas. Harald Nielsen, Bromley, and Bryan Laing, Petty France, England, assignors to Sensible Heat Distillation Limited, Westminster, England.—1,718,830.

### Inorganic Processes

Vanadium Alloy. Byramji D. Saklatwalla, Crafton, Pa., assignor to Vanadium Corporation of America, Bridgeville, Pa.—1,715,867.

Method of Obtaining Copper Sulphate. Max Speichert, Berlin-Tempelhof, Germany, assignor to Hüttenwerke Tempelhof A. Meyer, Berlin-Tempelhof, Germany.—1,715,871.

Composition for Producing Hypochlorite Solutions. Maurice C. Taylor, Niagara Falls, N. Y., assignor to Mathieson Alkali Works, Inc., New York.—1,716,014.

Process of Producing Aluminum Chloride. Henry Blumenberg, Jr., Moapa, Nev.—1,716,102.

Method of Making Pigments. James B. Pierce, Jr., Charleston, W. Va.—1,715,384.

Process of Converting Ammonium Chloride into Ammonia and Hydrochloric Acid. Jacob Kessler, New York.—1,718,420.

Process for Conversion of SO<sub>2</sub> to SO<sub>3</sub>. Jesse G. Melendy, Tarrytown, N. Y., assignor to General Chemical Company, New York.—1,716,498.

Process for Production of Potassium Carbonate. Robert D. Pike, Piedmont, Leo V. Steck, Oakland, and Ross Cummings, Berkeley, Calif.; said Steck and said Cummings assignors to said Pike.—1,716,663.

Process for the Production of Hydrogen-Nitrogen Mixtures. Luigi Casale, deceased, Rome, Italy, by Maria Casale-Sacchi administratrix, Rapallo, Genoa, Italy.—1,716,813.

Aluminum-Beryllium Alloy and Method of Treatment. Robert S. Archer and William L. Fink, Cleveland, Ohio, assignors to Aluminum Company of America, Pittsburgh, Pa.—1,716,943.

Production of Hydrogen and Carbon by Thermal Decomposition of Hydrocarbons. Arthur W. Burwell, Niagara Falls, N. Y., assignor to Alox Chemical Corporation, New York.—1,717,354.

Manufacture of Calcium Hypochlorite. Anthony George et al., Niagara Falls, N. Y., assignors to The Mathieson Alkali Works, Inc., New York.—1,718,284-7.

Process for the Production of Alkali-Metal Silicates That are Soluble in Water. Birger Fjeld Halvorsen, Oslo, Norway, assignor to Norsk Hydro-Elektrisk Kvaestofaktieselskab, Oslo, Norway.—1,718,292.

Noncorrosive Priming Mixture. Joseph D. McNutt, New Haven, Conn., assignor, by mesne assignments, to Winchester Repeating Arms Company.—1,718,370.

Mercury Fulminate and Method of Treating Same. Joseph D. McNutt, New Haven, Conn., assignor, by mesne assignments, to Winchester Repeating Arms Company, New Haven, Conn.—1,718,371.

Light-Metal Alloy. John A. Gann, Midland, Mich., assignor to Dow Chemical Company, Midland, Mich.—1,718,642.

Ferro-Aluminum Alloy and Method of Making It. Ralph P. De Vries, Menands, and Henry A. De Fries, Albany, N. Y., assignors to Ludlum Steel Company, Watervliet, N. Y.—1,718,685.

Apparatus for the Production of Carbon Black. Roy H. Uhlinger, Pittsburgh, Pa., assignor to Thermatomic Carbon Company, Pittsburgh, Pa.—1,718,720.

### Chemical Engineering Processes and Equipment

Centrifugal Drier. Peter C. Bruckmann, St. Louis, Mo., assignor, by mesne assignments, to Vordone Company.—1,715,351.

Process of Revivifying Spent Clarifying and Decolorizing Agents. Marvin L. Chappell, Los Angeles, Calif., assignor, by mesne assignments, to Contact Filtration Company, San Francisco, Calif.—1,715,535.

Production of Leather. Robert Howson Pickard, Dorothy Jordan Lloyd, and Albert Edward Counce, London, England.—1,715,621-23.

Process for Purifying Polluted Liquids and Industrial Waste. John T. Travers, Columbus, Ohio, assignor, by direct and mesne assignments, to Travers Corporation, Columbus, Ohio.—1,715,877.

Continuous-Filter Thickening Apparatus. Albert Legrand Genter, Salt Lake City, Utah, assignor to Genter Thickener Company.—1,716,040.

Process and Apparatus for the Separation and Recovery of Gases and Vapors by Solid Absorbents. Albert Godel, Lagnieu, France, assignor to Société de Recherches et d'Exploitations Pétrolières, Paris, France.—1,717,103.

Process of Making Refractory Composition and Articles Therefrom. Louis J. Trostel, Baltimore, Md., assignor to General Refractories Company, Philadelphia, Pa.—1,716,395.

Method of Producing Clarifying Reagents. John C. Merrill, Los Angeles, and Henry S. Montgomery, Pasadena, Calif.—1,716,828.

Centrifugal Drier. Alpheus W. Altorfer, Peoria, Ill., assignor to Altorfer Bros. Company, East Peoria, Ill.—1,717,646.

Revivification of Used Kieselguhr. Robert Calvert, Lompoc, Calif.—1,717,661.

Evaporator. Burton S. Hughes and Stanley Hughes, Buffalo, N. Y.—1,717,927.

Process of Separating Liquids. Erling H. Haabestad, Philadelphia, Pa., assignor to B. A. S. Company, Philadelphia, Pa.—1,716,957.

Comminuting Solid Substances. Walter Ostermann, Barmen-Langerfeld, Germany, assignor, by mesne assignments, to Industrial Spray Drying Corporation, New York.—1,718,184.

Water-Softening Filter. Harry Markham Marsh and Robert Stirling, Hamilton, Ontario, Canada, assignors to W. J. Westaway Company Ltd., Hamilton, Ontario, Canada.—1,718,244.

Dehydrator. Ellard L. Younger, Woodland, Calif., assignor to Younger Dehydrator Company, Woodland, Calif.—1,718,845.

# NEWS of the Industry

## Lime Industry Drafts Rules at Annual Meeting

**A**PPROXIMATELY three-quarters of the lime-producing capacity of the United States was reported at the annual meeting and trade practice conference of the National Lime Association held in Washington during the last week in June. Forward-looking action was taken by this gathering in presenting unanimously to the Federal Trade Commission a set of trade practice rules which it is proposed be approved for the guidance of this industry.

At the annual association meeting a vigorous program was adopted by the industry. The membership voted a three-year assessment based upon the tonnage production of lime. This insures the formulation of a full program of work which seems assured of large success because of the enthusiastic unanimity of action exhibited at the convention. The membership of the association was reported to have grown during the past eight months from about 32 per cent to over 50 per cent of the industry. The newly elected officers are assured of still further increases and it is confidently expected by them that fully 75 per cent of the productive capacity will take part in association affairs during the coming year.

The officers elected for the coming year are Norman G. Hough, president; R. P. Wilton, secretary-treasurer; and W. V. Brumbaugh, assistant secretary-treasurer. Both Mr. Hough and Mr. Brumbaugh will give their full time to the association work at the national headquarters in Washington, D. C. The executive committee will consist of the three officers named and J. M. Deely, Lee, Mass.; H. B. Mathews, Alton, Ill.; J. M. Gager, Chattanooga, Tenn.; and Reed C. Bye, Philadelphia, Pa.

The code of trade practices for the lime industry which was submitted for approval of the Federal Trade Commission includes rules forbidding unfair price discrimination, variation from published prices and terms, attack on the confidence and stability of the industry, secret rebates, commercial bribery, inducing breach of contract, selling products below cost, defamation of competitors, fraudulent containers, misrepresentation, imitation of trade marks and trade names, false branding, deviation from standards, and numerous other distribution subjects for which unlawful practices are defined. In so far as these rules are approved by the Federal Trade Commission subsequently

they will take the effect of legal rules governing the business of the industry thereafter.

## Numerous Mergers Effectuated in Chemical Field

**U**NCONFIRMED reports are being circulated to the effect that negotiations are under way looking toward the merging of chemical companies. The trend toward mergers in the chemical field may be seen by reference to such developments within a short period.

The Kalbfleisch Corporation recently announced that it had taken over the firm of J. A. Wiarda & Co. Shortly afterward came the announcement that the Kalbfleisch Corporation had merged with the American Cyanamid Company. Previously the American Cyanamid had taken over the Calco Chemical Company, which in turn had taken over the Crown Chemical Company and the King Chemical Company. Within the last two weeks came the announcement that a consolidation had been effected between the American Cyanamid Company and the Selden Company.

The United Chemicals, Inc., recently purchased more than 97 per cent of the outstanding capital of the Monarch Chemical Company. United Chemicals, Inc., for some time has owned a controlling interest in Westvaco Chlorine Products.

In the latter part of June the United States Industrial Alcohol Company completed arrangements to acquire the Kentucky Alcohol Corporation, which was a subsidiary of the National Distillers Products Corporation.

Last month the Newport Company purchased the assets and business of the Rhodia Chemical Company.

A little more than a month ago the Monsanto Chemical Company acquired the Rubber Service Laboratories Company and its subsidiary, the Elko Chemical Company.

In the latter part of June E. I. du Pont de Nemours & Company authorized the issue of additional shares of stock to complete the acquisition of the entire minority stock of Lazote, Inc. The du Pont Company previously owned the majority of Lazote stock.

On July 1 officials of the Hercules Powder Company announced that the company would assume full control of the Virginia Cellulose Company. In the last three years the cellulose plant had been operated as a separate unit of the Hercules Powder Company and made nitrocellulose from linters.

## A.I.Ch.E. Holds Convention at Philadelphia

**M**EETING in Philadelphia, the city in which it was founded 21 years ago, the American Institute of Chemical Engineers held one of its most successful conventions June 19-21. In addition to the technical sessions, reported elsewhere in this issue, the Institute gave attention to a number of important business matters. Prof. Harry A. Curtis of Yale University reported the preliminary recommendations of a committee appointed by President Alfred H. White to study the business organization and procedures of the Institute. The committee was of the opinion that the Institute had now grown to such an extent that it was warranted in setting up a permanent office and employing a full-time secretary.

The committee also proposed some important changes in publication policy—such as abandoning the present transactions and substituting an annual or even more frequent volume of chemical engineering reviews to deal with unit operations, industries and materials. Considerable discussion was evoked by the proposal to discontinue preprinting papers. The committee recommended that the papers be released to the authors after presentation at an Institute meeting and that the Institute exert no subsequent control on their publication except the usual requirement for credit to original source. The financing of the proposed program might conceivably involve increased dues although the present surplus in the treasury would take care of the situation for some time. No action was taken on the report except that the whole of the discussion was referred back to the Curtis committee for subsequent report.

The next meeting, it was announced, will be held in Asheville, N. C., Dec. 2-4, 1929. John D. Rue, director of research for the Champion Fibre Company, of Canton, N. C., was appointed general chairman. It also was announced that the council had invitations from Tulsa, Detroit and Baltimore for meetings in 1930.

The successful meeting in Philadelphia was in a large measure due to the work of the local committee under the chairmanship of Frederic J. LeMaistre. A. G. Peterkin, Jr., arranged the technical sessions, James G. Vail proved the efficient chairman of transportation, S. S. Sadtler had charge of registrations and receptions and J. Bennett Hill was chairman of the banquet and luncheon sub-committee.



## Chemicals Not Prominent in Tariff Protests

CHEMICALS have not figured prominently in the protests that have been received from foreign countries and their industrials against the new tariff. It is significant that neither the German government nor any commercial organizations in that country have made any representations through the medium of their diplomatic representatives in Washington. Among the foreign notes that have been made public by Senator Smoot, chairman of the Senate Finance Committee, is one from Prince de Ligne, the Belgian Ambassador, dated June 25, stating that "there is no doubt that if an increase of duty is made on phosphate of soda, the Société Anonyme de Pont Brule may have to close its doors."

"The principal Belgian manufacturer of chemical products," the note states, "is very much concerned in regard to phosphate of soda, *christa*. The importation of phosphate of soda into the United States is only about 4 per cent of the American output—i.e., for phosphate of soda, *bibasic*, 3 per cent, and phosphate of soda, *tribasic*, 1 per cent. The total consumption of these products has increased 550 per cent from 1924 to 1928, while the importations into the United States remain without increase. This fact would indicate that a duty of one-half cent per pound is sufficient to protect and develop the American industry of phosphate of soda. Furthermore, since the Belgian currency has been stabilized, the cost of Belgian production has been augmented and wages have been increased 100 per cent. It is to be noted that Belgium imports a great deal of raw material for the manufacture of phosphate of soda from the United States."

The present duty of one-half cent per pound on phosphate is raised in Paragraph 83 of the House bill to 1 cent a pound, when containing less than 45 per cent of water by weight; and to 2 cents per pound on phosphate not specially provided for.

## Institute of Politics Awaits Ninth Session

CARRYING on its efforts "to explore the facts underlying international events . . . and to create international good will," the Institute of Politics announces Aug. 1 to 29 as the date for its ninth annual session and Williamstown, Mass., as its place of congregation. One of the conferences, "Trade Relations as Affected by Politics, Science, and Finance," is now outlined in a draft syllabus prepared by Harrison E. Howe, chairman, and R. S. McBride, secretary, both of Washington, D. C. Items on the program of outstanding interest to the chemical industries are: "Nature, Origin and Purpose of Trade Barriers," by Thomas Walker Page, Aug. 2; "Tariff Operation in Europe and the United States," by C. R. De

Long, Aug. 5; "Corporate Structure of Foreign and International Cartels," by W. F. Foth, Aug. 9; and "World Peace as Affected by Science and Discovery," by E. R. Weidlein, Aug. 26.

## Chemical Conference Will Convene at Paris

WITH the idea of providing a better and a more extended service for the American chemical industry the Secretary of Commerce has authorized a conference of the officers in the European service who are reporting on chemical matters. The conference will convene Aug. 1 in Paris and will continue through Aug. 4, despite the fact that the latter day is Sunday. C. C. Concannon, chief of the Chemical Division, will meet with the commercial attachés, as will L. D. Domeratzky, head of the Bureau's Division of Regional Information. American trade organizations will be represented by Charles J. Brand, of the National Fertilizer Association, and Lewis H. Marks, of the Industrial Alcohol Institute. A. Cressey Morrison (chairman), G. Ober, and Dr. A. S. Burdick of the department's chemical advisory committee, will be present. Others to be in attendance are D. J. Reagan, acting commercial attaché at Paris, who will preside; William F. Daugherty, trade commissioner at Berlin; Homer S. Fox, trade commissioner at London; E. Humes, trade commissioner at Rome; Charles E. Lyon, commercial attaché at Berne; Clayton Lane, commercial attaché at Warsaw; and Earl Taylor, newly appointed fertilizer specialist attached to the Paris office of the Department of Commerce.

Particular significance is attached to this meeting, as on its success will depend the expansion of this policy. It is planned to discuss the present condition of the chemical industry in the various European countries. This will include reviews of resources, of exports and of all necessary imports. The production and market situations will be discussed with reference to inorganic industrial chemicals, fertilizers, paints, naval stores, organic chemicals, drugs, and fine chemicals. Trade possibilities for products manufactured in the United States will be analyzed in detail.

Movement of American capital into chemical industries in Europe will be outlined, as well as the movement of European capital among the various countries there. Important attention will be paid to the interchange of patents, licenses and formulas. The rights of foreigners to become shareholders in European chemical industries will be explained. Information will be given as to recent and pending legislation affecting the activities of foreign firms operating within European countries. A survey of the European sources of raw materials in which the United States is deficient will be presented, as will an analysis of transportation and packing regulations in the different countries of Europe.

## Electrochemists to Discuss Aviation Materials

THE American Electrochemical Society will hold its fall convention in Pittsburgh, Pa., Sept. 19-21, to discuss, among other subjects, the contributions of the American electrochemical industry to aeronautics. Several hundred chemists, metallurgists, plant executives and company officials of both the United States and Canada will then convene to discuss recent developments in the electrochemical industry.

The program will consist of visits to various industrial plants in the Pittsburgh district, and also technical sessions at which papers on electrochemical subjects will be presented by various prominent men from all over the country. There will be a special symposium on "Contributions of Electrochemistry to Aeronautics," with emphasis given to the light-weight aluminum and magnesium alloys used in aeroplane construction.

Social features of the meeting will include a smoker, a dinner and dance, and a special program for the ladies of the party.

## T. D. Lynch Elected President of A.S.T.M.

THE annual convention of the American Society for Testing Materials was held during the week of June 24, 1929, at Atlantic City.

Tillman D. Lynch, consulting metallurgical engineer of the Westinghouse Electric & Manufacturing Company, was elected president. Mr. Lynch has served the Society as a vice-president during the last two years. F. O. Clements, technical director of the research laboratories of the General Motors Corporation, was elected a vice-president of the Society to serve two years.

The Society's policy is to have the annual meeting every few years in the Middle West, consequently it is probable that next year's meeting will be held away from the Atlantic coast. Chicago is under discussion as the place of meeting.

## Network of Laboratories to Test Gasoline

ORGANIZATION of a national network of laboratories, linking the oil and automotive industries in a new and close-working association with chemistry and engineering, is announced by the Ethyl Gasoline Corporation, owned jointly by General Motors and the Standard Oil Company of New Jersey. This development, it is declared, substitutes science for empiricism in determining gasoline quality.

The system embraces a chemical laboratory at Yonkers, N. Y., devoted to fundamental scientific research in motor fuels; a technical laboratory in Detroit to aid automobile manufacturers in solving problems of construction, and a group of knock testing laboratories located at various geographical centers.

# NEWS FROM WASHINGTON

By Paul Wootton

Washington Correspondent of Chem. & Met.

**M**OST of the testimony taken by the Senate Finance Committee on the chemical schedule of the tariff bill simply was a repetition of statements previously made before the Ways and Means Committee or in defense of the action taken by the House. Requests for increased duties on blackstrap molasses, oils and fats and casein were urged strongly, as was the transfer of tapioca to the dutiable list. Despite the influence of the interests urging a high rate for blackstrap molasses, indications all are that the opposition has convinced the committee that corn growers would not benefit materially even were a prohibitive duty prescribed.

The oils and fats situation revolves around the Philippines policy. While the committee is not expected to change the House bill in this respect, there will be a determined effort to put through an amendment on the floor of the Senate limiting the amount of duty-free imports from the Philippines. Were the amendment to pass, however, it doubtless would be eliminated in conference.

The paper makers made such a convincing case in their opposition to the duty on casein that they appear to have persuaded the committee that it would be better for the dairy industry to retain that market rather than to spur paper manufacturers into the development of substitutes or into the manufacture of super-calendered paper.

**M**UCH is being made in the press of protests filed with the State Department by foreign governments. These requests bear all the earmarks of being perfunctory and the result of pressure which powerful industrial groups can bring on any government. Judging from the experience when other tariff bills have been under consideration they carry with them no menace to good commercial relationships. There are few countries in the world that do not have more objectionable features in their laws governing the entry of foreign goods than anything suggested in this bill.

Nearly anything is likely to happen on the floor of the Senate, as the administration leaders cannot count upon the support of the so-called insurgent group in the Republican ranks. The committee is likely to be overridden in numerous particulars when the bill is considered in the Senate, but the conference committee is conservative and it is likely that the bill finally sent to the White House will not differ greatly from that reported out by the committee.

Another part of the bill which has been singled out for organized attack is that which continues the flexible feature of the 1922 act. Since this runs counter to non-partisan thought among business men, it is not expected to be

successful. The provision of the present bill which allows the application of an American basis of valuation when foreign producers will not reveal their production costs, seems to be popular.

An analysis of the complaints which have been received indicates that there is no ground swell of consumer objection to the proposed rates. In most of these objections it is easily possible to identify a selfish reason behind the demand for lower rates.

**F**REE listing of all materials imported for fertilizer purposes was proposed by Chester H. Gray for the American Farm Bureau Federation in the Senate Finance Committee tariff hearing of July 11. This would affect ammonium phosphate, nitrate, and sulphate, which, however, would pay the present rates if brought in as pure chemicals.

Mr. Gray also advocated a duty on items directly or indirectly competitive with farm products, including such imports as sago, tapioca, cassava, and arrowroot starches; oil-bearing seeds; vegetable oils and tallows; and citrous juices. He asked 2½c. per pound on all starches. Over 70 per cent of starch imports are competitive, he said. On oils and oil-bearing seeds, the rates proposed before the Ways and Means Committee were again brought forward.

The farm position on items which, though not grown in the United States, replace domestic products, is typified in the case of bananas. By some method of reasoning it is argued that a duty of 75c. per bunch will place American fruit growers on a parity with banana producers. "This will not compel but will induce through the price equation" the purchase of domestic fruits in place of bananas, said Mr. Gray.

That crude oil be retained on the free list was urged by Senator M. E. Tydings, of Maryland. It would be absurd to promote an oil conservation policy, he declared, and at the same time force greater domestic production by restricting imports. At present the United States produces 68 per cent of the world supply, consumes and exports 966,000,000 bbl., and imports 64,000,000 bbl., according to figures cited. Senator Tydings pointed out that a duty would increase gasoline prices, working a hardship on the nation at large, especially on the farmer. Producers and users of asphaltum products also would suffer, he stated. The need for ample reserves in case of war emergency was stressed as an added reason for conservation.

**N**OTHING sinister is seen in Washington in the agreement entered into by German, British and Chilean producers intended to maintain the present relationship in prices of synthetic, by-

product and natural nitrates. While it is recognized that abuse is possible under such an arrangement, no information has been received thus far to indicate that anything other than constructive action is contemplated.

While it is admitted that one of the purposes of the agreement is to eliminate cut-throat competition, the main object of the understanding is to encourage greater use of nitrogen as a plant food. The synthetic nitrogen industry has grown so rapidly in the last two years that the world is facing ruinous overproduction, it is believed. The rate of consumption has lagged behind that of production. If demoralization is to be prevented, it is argued by those who expect good to result from the agreement, something must be done to stabilize prices and to stimulate the volume of sales.

It is pointed out in Washington that the parties to the agreement have it within their power to do very constructive work. If the operations under the agreement should be otherwise, it is pointed out that the understanding does not apply to sales in the United States and no American producer is a party to the plan. It has been demonstrated recently in the cases brought by the Department of Justice against the potash syndicate and the Kina bureau that the United States is in a position to protect itself against even foreign monopolies. Moreover, the prospects are that the United States will be free from the actual necessity of importing nitrogen by 1932. On the other hand, American farmers are using a much smaller amount of plant food than the agricultural specialists think they should use. One of the tasks which the new Farm Board is expected to undertake is a study of increased costs for labor and for overhead in the cultivation of more acres than are necessary to raise the same amount of product.

In this connection it is pointed out that the farmers who have gone into the dairy business have relied heavily upon science for the determination of feeding problems so that the maximum of butter fat may be obtained or so that cattle may take on meat if they are intended for slaughtering. Outside of the trucking regions, however, no such attention has been given the fertilization of the soil. This, it is asserted, results in high-cost products, which in various crops means a high-cost surplus. Issue also is taken with the use of the term "surplus." Attention is called to the fact that there are vast populations in the world that cannot afford to buy much wheat, for instance, at prevailing prices. If through the abundance of nitrogen it should come into common use and be a factor in reducing production costs, wheat consumption soon would rise to new high levels. According to this view there should be no talk of agricultural surpluses when half of the world is underfed. The problem of reducing costs so that more may be well fed is regarded as one which should challenge those attempting to improve the agricultural situation.



# Agreement Among Nitrogen Producers Interests British Trade

Agricultural Research Station of I.C.I.  
Industries Formally Opened

*From our London Correspondent*

NOW THAT the general election is out of the way, the country is endeavoring to settle down again and assess the probable effect of the altered conditions. Rationalization is still a catchword, although here perhaps more than elsewhere it is realized that it has its limitations and does not necessarily mean merely the amalgamation of a number of firms in similar lines of business, in order that its application shall be a success. Although there is some nervousness, particularly in the coal industry, in regard to uncertainty from any attempt to restore the 7-hour working day, or to restore trade union activities to their former status, the general view is that we are now at the threshold of at least twelve months of comparative peace and freedom from violent alterations in policy which would affect stability and confidence.

Probably the outstanding event of the past month has been the nitrate agreement, which is at last an accomplished fact. The immediate result of the decision of the Chilean, German and British producers (together with the Norwegian interest controlled by the I.G.) to co-operate in the production, marketing and propaganda of synthetic nitrogen products, has been the announcement of a substantial reduction in price. This amounts to about \$2.50 per ton of sulphate of ammonia or calcium nitrate, and as much as \$3.75 in the case of synthetic sodium nitrate. It seems to be fairly generally expected that these agreements will pave the way for understandings of a more international character and speculation is rife as to the probable opinion and reaction in the United States. It is thought that this will be influenced considerably by the friendly relationship which exists between the American producers of synthetic nitrogen and their British colleagues, and also by the recent financial participation of the Guggenheim interest in the Lautaro nitrate organization. The future of the I.G. development in Louisiana possibly will depend considerably upon the ultimate outcome of the present nitrogen price understanding.

THE new Agricultural Research Station of Imperial Chemical Industries near Windsor was formally opened on June 28 in the presence of most of the directors and a distinguished company which included Dr. Bosch and Dr. Bueb of the I.G. The two experimental farms total 436 acres, part of which is to be devoted to a special demonstration of the new system of "grass-land management." It will be shown that, presupposing, of course, a judicious use of fertilizer, a large herd of stock can be carried profitably on a holding as small

as 17 acres, while another 70 acres will be set aside for the production of "baby beef." The laboratories and general equipment are on a lavish scale, and evidently the policy of Imperial Chemical Industries as regards propaganda of this kind has been carefully planned in advance with considerable skill and courage.

Dr. Arthur D. Little, of Cambridge, Mass., president of the Society of Chemical Industry, has arrived, and is standing the strain of dinners and receptions remarkably well. Among the more interesting of these might be mentioned that tendered by the Institution of Chemical Engineers, and on June 26 by the intimate coterie known as the "Catalysts," where Dr. Little met the leading personalities in the chemical and scientific field untrammelled by convention or reporters. On June 28 he attended a reception at Prof. Jocelyn Thorpe's house, and there are already signs that his retinue of American colleagues at Manchester will be both considerable and influential.

A CERTAIN amount of development work appears already to be proceeding at the Dead Sea in connection with the concession which was recently granted and which was referred to in these notes last month. Haifa will be the port of shipment, involving an up-river railway line of 84 kilometers. It is estimated that potassium chloride from the Dead Sea can be delivered at New York at about \$38 per ton, and although for some years a total production of 100,000 tons may be the economic limit, the ultimate goal is said to be a million tons per annum. Whether and to what extent local markets can absorb some of this production remains to be seen, but obviously many years must elapse before there can be an appreciable effect upon the present distribution and supply of potash salts.

Reference also was made last month to the new Lilienfeld processes, which, as should have been stated, relate to the treatment of cotton and not synthetic resins. A syndicate has been formed jointly with the British Cyanides Company to demonstrate the value of these new processes, and the nominees appointed to the board of directors by Dr. Lilienfeld include a distinguished consulting chemist whose name alone is an indication of the importance of this development.

Some attention has also been given by other interests to the processes of Dr. Franck, of Berlin, aiming at the production of non-inflammable paper, which is said to withstand temperature of 600 deg. C.

The rayon industry is again exhibiting signs of recovery. There are substantial rumors that some of the smaller producers are contemplating either amalgamation or other working arrangements in order to prevent overlapping and excessive competition. One or two of the companies formed during the boom have already gone to the wall, while others, like the Branston Company, are expanding their output. Among the acetate silk factories, the Apex Company appears at last to be turning the corner after a somewhat painful journey. Similarly, the Non-Inflammable Film Company, which is closely associated with the Cellulose Acetate Silk Company, is at last ready to manufacture a very excellent product on a commercial scale. The future progress of the company is likely to be materially assisted by the recent reorganization of the board of directors, which now includes, together with Dr. Levinstein, Sir Ivor Phillips, of the Ilford photographic concern.

WRITING in lighter vein for a change, reference might be made to the Complex Research Company (U.S.A.), Ltd., which has been formed to acquire the exclusive right to use in the United States a secret process or formula for the scientific manufacture of gold. This seems all wrong, because it might have been assumed that the proper procedure would be to manufacture the gold in this country for export to the United States instead of vice versa. As the nominal capital is only £100, and as it is not stated whether this is in gold, it seems probable that the title selected for the company is fully justified.

Particulars are advertised of Metafilters, Ltd., a company with a capital of \$400,000 to exploit the invention of J. A. Pickard, who formerly was with the Stream-Line Filter Company. Mr. Pickard's metafilters utilize filter aids in an ingenious manner and appear to be particularly applicable to the bulk filtration of beer, wine, oils and other liquids.

## Consolidation of Palm Oil Companies Reported

CONSOLIDATION of the African & Eastern Trading Corporation with the Niger Company in this country following the merger of the parent organizations in London, is said to have been formally accomplished with the filing of a charter for a new Delaware company known as the United Africa Company, capitalized with 10,000 shares of no par value stock.

The foreign concerns which amalgamated after engaging in a competitive war for the palm oil and cocoa trade of West Africa for many years, hold equal interest and control in the new parent company, United Africa, Ltd., which has an authorized capital of £14,000,000. Virtually all of the stock in the Niger Company is held by Lever Bros., Ltd., the soap and vegetable oil manufacturers. The African & Eastern Trading Corporation yielded practically all of its properties to United Africa.

# French Chemical Companies Show Large Financial Returns

Net Profits Reach Large Totals Despite Heavy State Taxation

*From our Paris Correspondent*

**W**E HAVE already mentioned the rising prosperity of the French chemical industry, in spite of exaggerated fiscal taxation. The following figures will illustrate the above statement: In 1928 for a working capital of 205,000,000 francs Saint Gobain, one of the oldest French firms, made a profit of 58,000,000 fr., Alais Froges Camargue made 58,000,000 fr. on a capital of 208,000,000, fr. and Kuhlmann's (whose capital has recently been raised from 250,000,000, to 300,000,000 fr.), netted 40,000,000 fr. Other firms also show good returns for the capital invested: Bozel-Maletra made 15,000,000 fr. on 80,000,000, fr. capital; Saint-Denis Colouring Matters Co., 9,500,000 fr. on 40,000,000 fr. capital; Rhône-Poulenc, 28,000,000 fr. on 38,000,000 fr. capital; l'Amoniaque Synthétique, 4,000,000 fr. on 45,000,000 fr. capital.

The Coignet Co. (Produits Chimiques Coignet), whose close relationship with Kuhlmann's is well known, showed a profit of 9,000,000 fr. on 14,000,000 fr. capital. Cotellet & Foucher, who are connected with Solvay, showed 6,000,000 fr. profit on 15,000,000 fr. capital. Among the other important companies the following also show excellent returns on the capital invested: Société Chimique de la Grande Paroisse (Nitrogen and Chemical products), 8,250,000 fr., Marcheville-Daguin & Co. (also known as Comptoir de l'Industrie du sel et des Produits Chimiques de l'Est), 15,000,000 fr., and the Ripolin Co., 22,000,000 fr.

The French metallurgical industry is now in a favorable position, having gained new foreign markets. Its steel and cast-iron output has doubled since the return of Lorraine to France and the custom union made with the Sarre districts. The steel output now reaches 10,000,000 tons, half of which is exported.

**F**RANCE is one of the large producers of turpentine. French turpentine comes from the Landes districts. Strenuous research is being made at the Bordeaux Pine Institute to develop improved methods of separating turpentine from rosin and of extracting byproducts which would naturally give a higher market value to both rosin and turpentine. The director of the Pine Institute, Mr. Dupont, has published interesting reports on the subject. Mr. Austerweil, an authority on pinene and nopinene, has discovered a new super-turpentine, both an excellent solvent and the basis of synthetic

camphor. This new synthetic camphor is being manufactured at La Rochelle by the Compagnie Alsacienne de Produits Chimiques, the total output being 80 tons per month.

This super-turpentine is used also for the making of terpineol, the basis of soap perfumes. Mr. Delsabres, of the Pine Institute, states that France produces 150 tons of terpineol, that about one-third of the output is exported, and that the terpineol industry will be extensively developed in France, where inexhaustible supplies of rosin may be found. Mr. Delsabres further states that the world's consumption of terpineol is about 2,000 tons, of which 500 tons is supplied by Germany.

According to Mr. Delsabres' views terpineol melting at 35 deg. C. may be used as plasticizing matter in alcohol and oil varnishes. Twenty-five per cent of terpineol should be added, giving a shiny and lasting gloss. Terpineol is also an excellent solvent for hard gums and semi-hard gums, but as it must be warmed under pressure in the autoclave, this operation is rather complicated.

**T**HE importance of the artificial rosin trade, of the formophenolic rosins trade especially, is well known in chemical circles. More than 13,000 tons of artificial resinous compounds was produced last year, about 5,000 tons being used by the electrical trade, whose needs are still steadily growing.

This synthetic resinous compounds industry was only recently introduced in France, in 1922, with a yearly output of 100 tons. Today the French output represents only 8 per cent of the world's output, 40 per cent being supplied by the United States, 16 per cent by Great Britain and 25 per cent by Germany.

A new development of the artificial rosin trade is being contemplated in France, owing to the activity of the Société Huiles, Goudron & Dérivés. This firm is closely connected with the Mines of Lens and has already absorbed one of its competitors, the Société Chimique de La Drôme, which has been producing about one-third of the total present French output. The Huiles, Goudrons & Dérivés Co. will take over the Sté. Chimique de La Drôme's plant at the Bourg-lez-Valence works in southern France and bring it northward in the Lens mining district, where coal carbonization factories are. These works produce coal byproducts such as phenols, methanols (out of which formol is made), also ammonia, all raw materials for the resinous compounds industry. The new

works at Lens therefore is in a much better position than the former Bourg-lez-Valence works, and not only will the cost price of the finished article be greatly reduced but the former monthly 100 ton output will be shortly doubled and even trebled.

Two French scholars well known in all international chemical circles, Charles Moureu and Léon Lindet, both members of the French Academy of Science, died recently.

The late Charles Moureu made highly interesting researches on acetylenic hydrocarbons, on sparteine, on acrolein, on the atmospheric rare gases and on anti-oxygen compounds. He clearly showed by his anti-oxygen catalysis experiments that the study of oxygen, which surrounds all bodies and compounds, opens an incommensurable field of new discoveries.

The late Léon Lindet was a professor of the Agricultural Institute of France. His researches were mostly made on animal and vegetal physiology applied to all compounds of natural and patent foods, also on the transformation and chemistry of foods.

## Canadian Company to Build Nitrogen Plant

**T**HE Consolidated Mining & Smelting Company is planning to erect a plant for fertilizer manufacture at Trail, B. C., Canada. The first unit will represent an expenditure of \$8,000,000. Last year the Consolidated Mining & Smelting Company reported that a chemical fertilizer distributed for experimental purposes and manufactured in its plant at Trail had produced satisfactory results. It is thought that the building of a large fertilizer plant, one section of which will be used for nitrogen fixation from the air, is based on the success of the earlier experiments. Full details are not yet available but it is reported that the plan calls for the installation of an electrical unit with an initial horsepower of 30,000.

## Cellulose Nitrate Films Banned in New York

**E**FFECTIVE Sept. 1, the sale or distribution of cellulose nitrate film for X-ray purposes will be prohibited in New York State, outside New York City, it was announced last week through the State Department of Health. The department has been informed that similar action will be taken by the Board of Health of this city, which has jurisdiction in all health matters here.

A resolution prohibiting the sale of inflammable film was adopted on June 26 by the State Public Health Council upon the recommendation of the special committee appointed by Lieutenant-Governor Lehman to investigate the hazard attendant upon the use of cellulose nitrate film in New York State. The disastrous fire in Cleveland recently is said to have prompted this action.



# Lignite Distillation Discussed at German Technologists Meeting

## Preparation and Application of Colloidal Hydroxides Described Before Chemists

*From our Berlin Correspondent*

AT THE 80th annual meeting of the German Society of Gas and Water Technologists, at Berlin, the paper by Dr. Czako, Frankfurt, treated lignite distillation in Upper Hessa in connection with power generation. The plant for this purpose operated by the Gewerkschaft Friedrich, Hungen, and that of "Hefrag" at Wölfersheim are the first two that carry through a complete utilization of lignite at the point of its production and distribute no coke but only tar and electrical energy. The only existing layout of a combined combination, gas, and electric plant is substantially as follows: Cleaned lignite, broken down to a particle size of 20-25 mm., is dried from 50-60 per cent moisture to about 15 per cent in driers operated with exhaust steam of the turbines in the power station. After being freed of fine dust the material is then treated at 500 deg. C. The gases are separated from the tar by gradual cooling and condensation and then washed of light oil vapor with benzene. This clean gas is then used in underfiring the distillation ovens, the excess going to the boilers of the power plant or to long-distance gas lines.

The tar is the main product, intended by virtue of its high market value to guarantee the financial success of the process. The coke is ground to powder and fed, together with dry coal dust, to the high-pressure boilers, thus being completely utilized for steam generation. The size of the distillation plant must be selected in precise accord with the coke demand of the power plant. The author incidentally spoke of a process for using lignite tar in the carburetion of water gas, which has already had practical trial. The distinguishing features are the forced injection of a vaporous tar-water mixture which can be regulated at the entrance to give a heating value up to 5,000 cal. The tar consumption for producing a 4,200-cal. water gas is very slight. The Hessian plants here referred to could generate annually, by this process, over 100,000,000 cu.m. of carburetted water gas having the same qualities of a good gas from coal.

AN INTERESTING process for sulphur removal from gas is reported by Dr. F. Neuwirth. In the research laboratory of the Oesterreichischen Montangesellschaft it was found that a local ligneous coal, steam-dried, had a great absorptive affinity for various gases and behaved much like activated carbon. Slow passage of a coal gas over this dried lignite resulted in the removal of 80-90 per cent of the hydrogen sulphide and simple treatment with superheated steam regenerated the coal for fresh use again. Similar trials with

the coke from this coal, activated at 800 deg. C. with  $\text{CO}_2$ , showed an even more active absorption. Finally, similar trials with the raw ligneous coal gave the surprising result that it has by far the most favorable action, especially at a raised temperature of preferably 70-80 deg. C., and that it could be regenerated by mere wetting with water. Quantitative tests after a 15th regeneration still showed a removal of 98 per cent, 600 gr. of coal absorbing 77.8 gr. of sulphur. Sulphur dioxide was removable in the same way, in fact the process has suggested itself strongly for American use for various cracking gases and the like, since a similar coal may very possibly occur there too.

Up to now, nitroglycerine preparations have been prohibited for military uses because of their great sensitivity, but Dr. A. Stettbacher, of Zurich, has succeeded in making a mixture of 20 per cent nitroglycerine and 80 per cent pentaerythrite-tetranitrate which should remove this difficulty. The compound is called Penthrinit and has extraordinary explosive powers, besides its stability to shock. Its coming popularity is further promised by the relative economy of production by standard electrochemical means.

AT THE general meeting of the Verein Deutscher Chemiker at Breslau (reported in part in this department for June) the section on inorganic chemistry selected "Hydroxides" as the principal topic of discussion. Dr. Kraut, Dortmund, spoke on the preparation and applications of the colloidal hydroxides. The latter are finding increasing scientific and industrial use as absorbents, catalyzers, and catalyst-carriers, especially the gels of silicic acid, as well as the hydroxyl gels of iron and aluminum which are qualified as absorbents in cleaning enzymes.

In speaking of their preparation the speaker outlined a useful method starting with aluminum sulphate which, by the addition of ammonia enriched with an ammonium salt, yields the orthohydroxide. An ammonia content of 15 per cent gives a minimum solubility (poly-aluminum hydroxide B) but a higher concentration raises the solubility and water content. Hot ammonia converts colloidal orthohydroxide into coarse, microcrystalline, and polyhydroxide B into still coarser polyhydroxide A. A conspicuous instance of the pH influence is the hydrolysis of silicon tetrachloride in water. A low pH concentration gives only a soluble monosilicic acid which gradually turns to a gel. Further factors are the temperature and time. In aging, gels change in either increased particle size, rearrangement, or in chemical composition.

The most soluble stannic acid,  $\text{Sn}(\text{OH})_4$ , is stable for only very few hours and must hence be isolated with a centrifuge. By isolating an aluminum orthohydroxide by centrifuging instead of decanting, a still more readily soluble isomeric or polymeric orthohydroxide is produced. Like the other, it can also be mineralized by hot ammonia without change in composition. These compounds lose this property after a few hours, only to receive it again weeks later, on transition to the stable orthohydroxide.

Along more peaceful paths the I.G. at Leverkusen has developed a very effective system for guarding against moth damage. By studying the types of color and material attacked and the poisons hitherto used, it succeeded in producing a wholly new substance which is applied to the wool in a dye bath and becomes fast to light, washing and wear. Hence no special procedure is necessary to dye and treat the wool simultaneously and since the substance, Eulan, is impregnated, the wool may be further fabricated without impairing its moth-resisting qualities.

## Natural Sodium Compounds in 1928

PRODUCTION of sodium compounds, not including common salt, from natural salines and brines in this country in 1928, as indicated by sales or shipments by producers, amounted to 206,380 short tons, valued at \$5,389,728, according to the United States Bureau of Mines. These figures include the output of sodium carbonate (soda ash), sodium bicarbonate, sodium sulphate (salt cake and glauber's salt), trona, and sodium borate (borax and kernite), and show a large increase in both quantity and value as compared with 1927 partly on account of the continued development of kernite deposits.

The sodium carbonates reported were all from California and amounted to 79,830 short tons, valued at \$1,578,256. They were produced from Owens Lake, Inyo County, by the Clark Chemical Company (product marketed as liquid caustic), Lone Pine, the Inyo Chemical Company, Lone Pine (soda ash, and sodium bicarbonate), the Kuhnert Syndicate, Bartlett (soda ash), and the Natural Soda Products Company, Keeler (soda ash, sodium bicarbonate, and trona), and from Searles Lake, San Bernardino County, by the Westend Chemical Company, Westend (soda ash).

The sales of sodium sulphate amounted to 6,580 tons, valued at \$42,485. Sodium sulphate (salt cake) was produced at Clarkdale, Ariz., by the Sodium Products Corporation; and at Wabuska, Nev., by the American Sodium Company. The 99 Company, at Okanogan, Washington, produced a small amount of sodium sulphate, but none was marketed. Hydrated sulphate (glauber's salt) was produced at Casper, Wyo., by D. W. Gill.

## Lautaro Nitrate Co. to Use Guggenheim Process

THE Guggenheim Brothers and the Lautaro Nitrate Company, Ltd., both interested in the extraction of Chilean nitrates, have closed negotiations for the use of the Guggenheim process by the Lautaro Nitrate Company, a British consolidation. Negotiations were conducted under the auspices of the National City Company which, in association with the Bankers Company of New York, Brown Brothers & Company, Lehman Brothers and the Continental Illinois Company, Inc., will handle the \$2,000,000 bond issue in connection with the deal.

The bankers will offer 6 per cent convertible first mortgage bonds, the investors having an opportunity to purchase bonds of one company and stock of another in a single operation.

The Lautaro Nitrate Company, Ltd., owns 418 square miles of nitrate-bearing land in Chile. To obtain for their holdings the benefits of the Guggenheim process, stockholders of the Lautaro Nitrate Company, Ltd., are to trade their equity for fixed dividend stock, thereby releasing to Guggenheim Brothers a part of that equity. In return Guggenheim Brothers have agreed to transfer their process to the Anglo-Chilean Consolidated Nitrate Corporation in which they own a majority stock interest, while Anglo-Chilean in turn grants a license to the Lautaro company.

## Great Britain Increases Output of Dyes

THE total production of dyestuffs in Great Britain in 1928 amounted to 50,907,080 lb., representing an increase of more than 11,355,000 lb., or nearly 29 per cent above the corresponding output in 1927, according to compilation of data by the Board of Trade, prepared from returns furnished by the principal British dye makers. The production last year was about five times that of the period immediately preceding the world war. With the exception of 1925-6, when there was a small decline of the British output of dyes largely as a result of the generally depressed conditions of industry, there has been a steady increase in recent years in the total output of dyes in Great Britain as well as in the range and quality of the products made. The increase recorded last year, however, is the largest in recent years.

A total quantity of 5,030,511 lb. of dyes was licensed for importation in 1928 (as distinct from the actual imports), according to Board of Trade figures. This is equivalent to approximately 10 per cent of production in the same year and is nearly double the quantity licensed in 1921, since when there has been a fairly steady increase in the quantities licensed for importation under the dyestuffs (import regulation) act. The actual number of licenses granted in 1928 was 7,051,

which is about 300 more than in 1927 and about 500 less than the number of applications received. In other words, about 94 per cent of the total number of applications for dyestuff import licenses were granted, those rejected being for goods that, in the opinion of the Dyestuffs Licensing Committee, may be supplied by British makers without disadvantage to the consumer either as to price or quality.

## National Standardization in Prospect

A CO-OPERATIVE agreement between the American Standard Association and the U. S. Bureau of Standards, which will encourage national standardization activities in all industries was ratified July 9 by George K. Burgess, director of the Bureau, and by the association's board of directors.

The board of directors decided to launch an extensive national campaign to finance industrial standardization activities. A finance committee was appointed for this purpose.

Under the terms of the agreement with the Bureau of Standards the primary effort of the Bureau will be to serve those industrial groups which have no satisfactory standardization facilities of their own. The bureau will help these groups to formulate temporary standards designed to meet immediate requirements.

Among the member bodies of the association are the American Institute of Mining and Metallurgical Engineers, the American Mining Congress and the International Acetylene Association.

## Japan Subsidizes Soda Ash Trade

CONTINUED agitation for the greater development of the soda ash industry in Japan has resulted in the granting of a subsidy of 213,000 yen for the current year, according to information sent to the U. S. Department of Commerce by the assistant trade commissioner at Tokyo.

The progress of this industry in Japan has been retarded by the uncertain cost of the raw material (common salt) which is obtained from China. Fluctuations in the value of the domestic output per ton are said to be due to variations in salt prices. Production and value per ton in recent years were as

follows: 1824, 2,206 short tons, valued at 329 yen per ton; 1925, 12,304 tons, 90 yen per ton; 1926, 19,089 tons, 45 yen per ton; 1927, 25,496 tons, 175 yen per ton.

Imports of soda ash are composed largely of natural soda from Lake Magadi, supplied by the British, and natural soda (trona) from the United States. During recent years the imports of natural sodas and soda ash combined were as follows: 1924, 131,005 short tons; 1925, 143,314; 1926, 40,297; 1927, 110,477; 1928, 86,513.

## Silica Gel Patents Upheld in German Courts

A REPORT from Baltimore states that the German Patents Court of Appeals has confirmed the validity of the basic patents on silica gel against the contentions of the Interessengemeinschaft Farbenindustrie. Litigation involving rights in the production of silica gel has been carried on in the German courts for eight years. According to the report the appellate court has upheld completely the claims of the Silica Gel Corporation, which is a subsidiary of the Davison Chemical Company.

## INDUSTRIAL NOTES

MONSANTO CHEMICAL WORKS announces that its subsidiary, Graesser-Nonsanto Chemical Works, Ltd., has purchased the assets of the British Saccharin Manufacturing Company, Baxenden, England.

CONSOLIDATED ASHCROFT HANCOCK COMPANY, INC., has moved its general sales office from New York to Bridgeport, Conn., with W. P. Bradbury, general sales manager, and has appointed N. B. Carlton western sales manager at Chicago.

STEPHENS-ADAMSON MANUFACTURING COMPANY, Aurora, Ill., has appointed H. W. Newton district manager of the office at 1108 Martin Building, Birmingham, Ala.

GRISCOM-RUSSELL COMPANY has opened a new sales office at the Lewis Building, Portland, Oregon.

CARRIER ENGINEERING CORPORATION, Newark, N. J., announces a new sales office at Buhl Building, Detroit, under the direction of Herbert Peacock.

YBOMANS BROTHERS COMPANY, Chicago, has appointed Ryan Sales Company, 1122 Stahlman Building, Nashville, Tenn., as representative in that territory.

HANSON-VANWINKLE-MUNNING COMPANY, Matawan, N. J., has made appointments as follows: H. R. Smallman, manager of Chicago office at 549 West Washington Boulevard; H. M. Cherry, manager of Detroit office at 5415 12th Street; L. M. Hague, manager of Pittsburgh-Cleveland office at 106 Liberty Avenue, Pittsburgh.

COMBUSTION ENGINEERING CORPORATION has appointed district managers as follows: T. W. Battle, 919 Johnston Building, Charlotte, N. C.; I. S. Forde, Candler Building, Atlanta, Ga.; E. C. Walthall, 118 Union Indemnity Building, New Orleans.

CHARLES A. NEWHALL, consulting chemist, has opened a new office at 2705 Smith Tower, Seattle, Wash.

## CALENDAR OF FORTHCOMING EVENTS

AMERICAN CHEMICAL SOCIETY, 78th meeting, Minneapolis, Sept. 9-13.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Sept. 24-26, Richmond; Sept. 27, Washington, D. C.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, winter meeting, Asheville, N. C., Dec. 2-4.

AMERICAN ELECTROCHEMICAL SOCIETY, fall meeting, Pittsburgh, Sept. 19-21.

NATIONAL METAL CONGRESS, held in conjunction with metal societies, Cleveland, Sept. 9-13.

RUBBER SECTION, AMERICAN CHEMICAL SOCIETY, fall meeting, New York, Sept. 26-28.



# MEN

## in Chemical Engineering

ERIC RANDOLPH JETTE, associate professor of chemistry at New York University, has been appointed a professor in the School of Mines at Columbia University. Professor Jette's work will center around research in metallurgy, founded on a basis of chemistry and physics.

CYRIL B. CLARK, formerly with the General Chemical Company, has now joined the Nitrogen Engineering Corporation at New York, to engage in new work on sulphuric acid.

A. E. R. WESTMAN, who has been associate professor of ceramics at Rutgers University, has resigned to join the staff of the Ontario Research Foundation at Toronto, Canada, beginning July 1.

K. A. TAYLOR has joined the research department of the Oxford Paper Company at Rumford, Me., having received his doctor's degree at McGill University.

NORMAN G. HOUGH, who was vice-president and sales manager of the Universal Gypsum & Lime Company,



NORMAN G. HOUGH

Chicago, has been elected president of the National Lime Association, to whose duties he will devote his full time in Washington.

F. A. MERRICK, for the past four years vice-president and general manager of the Westinghouse Electric & Manufacturing Company, has been elected president of that concern. Mr. Merrick's career began with a technical education at Lehigh University, from which he went to the Lorain Steel Company, later absorbed by the Westinghouse company.

A. H. COOPER, graduate chemical engineer in 1929 from the University of Tennessee, where he also was editor of *The Tennessee Engineer*, has joined the staff of *Chem. & Met.* for work during the summer months as editorial apprentice. A similar position on the magazine *Power* is being filled by EDWARD S. PATTISON, who was graduated in chemical engineering from Rensselaer in 1929.

A. E. MARSHALL, who is engaged in consulting chemical engineering work at Baltimore, Md., has opened an office in New York at 501 Fifth Avenue, where most of his future time will be spent.

RALPH H. MCKEE, professor of chemical engineering at Columbia University, was recently made honorary Doctor of Laws at the University of Maine, where he headed the department of chemistry and chemical engineering from 1909 to 1916, and honorary Doctor of Science at Wooster College, Ohio, where he originally received his bachelor's degree.

LINCOLN T. WORK, of Columbia University, is spending the summer with the division of chemical engineering research at the experimental station of the duPont company, Wilmington, Del. Dr. Work will return to Columbia in the fall to his position as assistant professor of chemical engineering.

CHARLES J. BRAND, secretary of the National Fertilizer Association, sailed on June 29 aboard the *Statendam* for Europe, where he attended the Fifth Congress of the International Chamber of Commerce and will partake in the conference at Paris of American attachés.

THOMAS W. STONE has been elected vice-president of the Western Gas Construction Company, following a career with his firm that began on his graduation in 1902 and progressed through the position of chief engineer.

TILLMAN D. LYNCH was elected successor to G. W. Thompson as president of the American Society for Testing Materials at its annual convention in Atlantic City on June 25. Mr. Lynch is consulting metallurgical engineer of the Westinghouse Electric & Manufacturing Company, a connection which he has maintained since 1899.

## OBITUARY

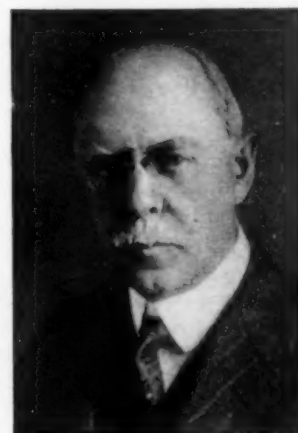
HENRY W. WENDT, president of the Buffalo Forge Company, Buffalo, N. Y., died at his home in that city on June 12 after a brief attack of pneumonia. He was 67 years old and a brother of the firm's founder, William F. Wendt. He had always been most actively interested in the technical side of manufacture, having once been president of the American Foundrymen's Association.

EDWARD H. SQUIBB, former president of E. R. Squibb & Son, Brooklyn, died of heart disease on July 6 at his summer home in South Harwich, Mass. As the son of the founder of the pharmaceutical chemical concern, he attended Brooklyn Polytechnic Institute, University of Vir-

S. W. PARR, president-elect for 1929 of the American Chemical Society, has presented his resignation from this post as a result of imperative demands on his time.

S. D. KIRKPATRICK, editor of *Chem. & Met.*, has been appointed to the vice-presidency of the American Electrochemical Society left vacant on the election of F. C. Frary to president.

ARTHUR D. LITTLE, president of Arthur D. Little, Inc., Cambridge, Mass., delivered a presidential address on "Science and Labor" before the Society of Chemical Industry at Manchester, England, on July 9. During



ARTHUR D. LITTLE

his further stay in England Dr. Little will receive two honorary degrees, Doctor of Science from the University of Manchester and Associateship in the Manchester School of Technology. He expects to return to this country late in August.

JAMES E. MILLS, who has been director of research of the Chemical Warfare Service at Edgewood Arsenal, has been selected as chairman of the division of chemistry and chemical technology of the National Research Council for the fiscal year beginning July 1. H. A. CURTIS, of Yale University, will serve as vice-chairman of the division.

ginia, and Harvard. Since his retirement from the active leadership of the firm several years ago, he had continued on its board of directors.

LOUIS SPRECKELS, for many years general manager of the Federal Sugar Refining Company, died suddenly at his home in Yonkers, N. Y., June 29, of a heart attack at the age of 62. Mr. Spreckels belonged to a family long prominent in sugar manufacture. Born and educated in San Francisco, he was taken into the business of his uncle, Claus Spreckels, who founded the firm. After a series of promotions in the San Francisco plant he was made an official in the Philadelphia plant, and almost 25 years ago was transferred to Yonkers as general superintendent.

# ECONOMIC INFLUENCES

## on production and consumption of CHEMICALS

### Chemical Production in First Half of Year Established Record

#### Activity in General Manufacturing Lines Increased Demand for Chemicals

ON THE authority of the American Bankers' Association the composite balance sheet of American business at the close of the first half-year reveals a strength and liquidity of position surpassing anything ever achieved in the past.

All three of the mainstays of the present era of prosperity continue to give a good account of themselves, with the steel industry operating at the rate of 57,000,000 tons annually, and the automobile industry aiming at an output of over 6,000,000 vehicles. Building construction has fallen only 12 per cent behind last year, in spite of the scarcity of mortgage money. A score of other industries of scarcely less importance have established new high production records in the period.

The surprisingly high rate of activity in manufacturing this year is now showing up in the statistics that are available covering the first five months, with June estimated, and it will be found that in no less than 25 major in-

dustries there were apparently established new high records in the half-year just passed. These include pig iron and steel, automobiles and trucks, airplanes, motor boats, tires, crude petroleum and gasoline, farm implements, machine tools, electrical apparatus, copper, plate glass, sulphuric acid, silk and rayon, cotton goods, clothing, newsprint, flour, bakery and dairy products, confectionery and cigarettes.

AS chemicals form an important part of the raw material supply for the majority of manufacturing industries it may be deduced that the record output of manufactures had a corresponding effect upon the output and distribution of chemicals and related products. All reports agree that the output of alkalis has exceeded that for the corresponding period of last year. Trade estimates indicate a larger production of sulphuric acid on the part of acid manufacturers, while the fertilizer trade is credited with an acid output of 913,890

tons for the first five months of this year, which compares with an output of 943,832 tons in the first six months of 1928.

Rayon production so far this year has far exceeded that as given in estimates at the beginning of the year. The estimates placed rayon production for this year at 130,000,000 lb., whereas at present indications it is estimated that production will approximate 170,000,000 lb.

The solvent industry also deserves special mention because of the increased volume of production this year. This industry has been aided by the record outturn of automobiles and to the latter also may be attributed the stimulus given to production of plate glass, tires, and other lines into which chemicals enter.

Based on consumption of electrical energy, *Electrical World* estimates that manufacturing plants operated in June at a rate 16.1 per cent higher than in June, 1928. The index for chemical manufacture was given at 133.8 for June as against 122.6 for June last year, or a gain of 11.2 per cent.

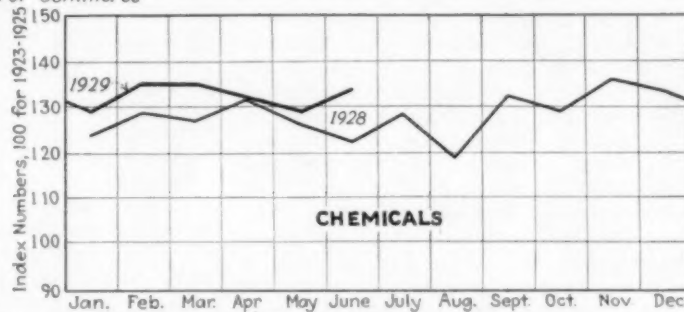
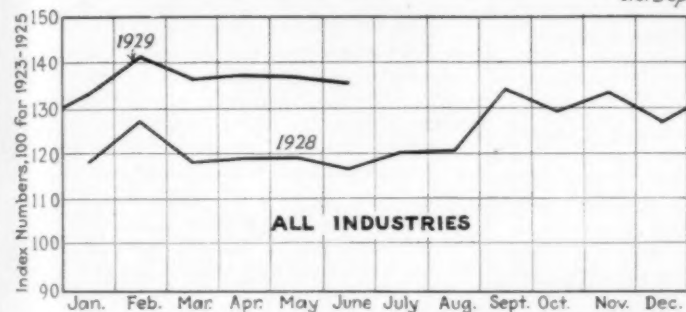
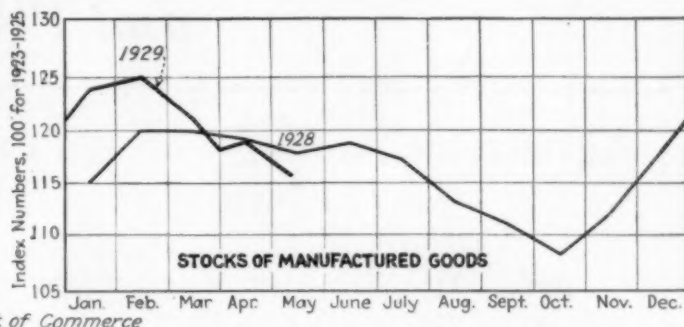
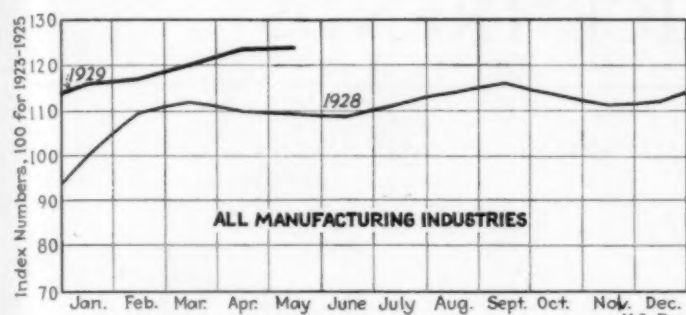
The outlook for chemical production in the third quarter also is very favorable, the most definite basis of calculation being found in the report that car requirements for moving chemicals and explosives in the quarter will be 27,387 against 26,070 used last year.

#### Production and Consumption in Specified Chemical and Chemical-Consuming Industries, January-May, 1928-1929

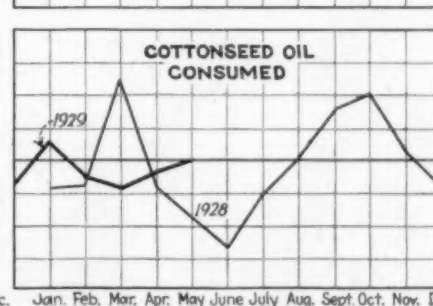
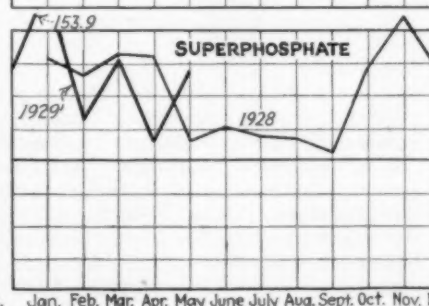
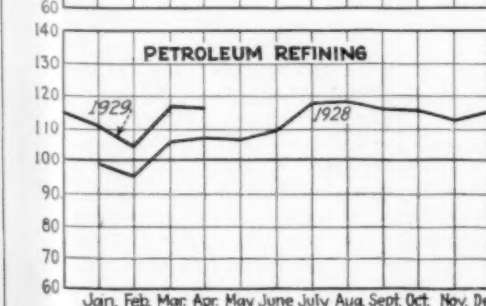
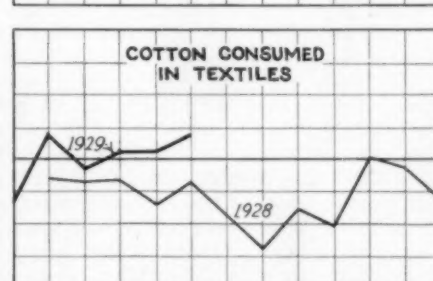
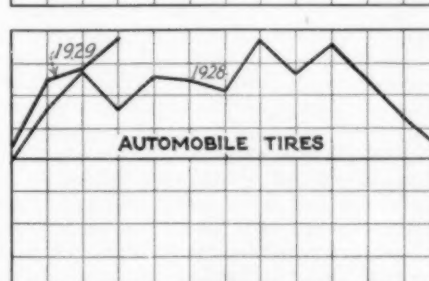
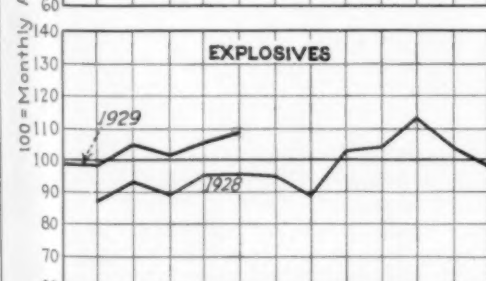
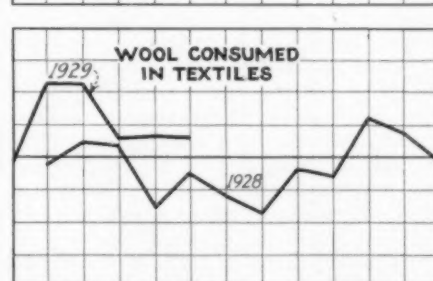
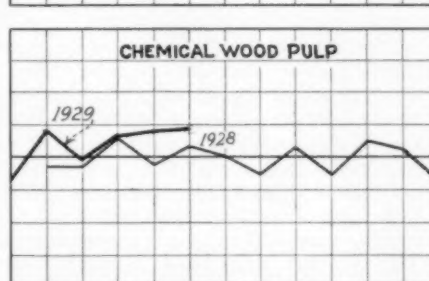
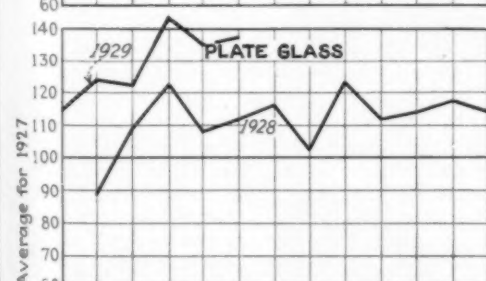
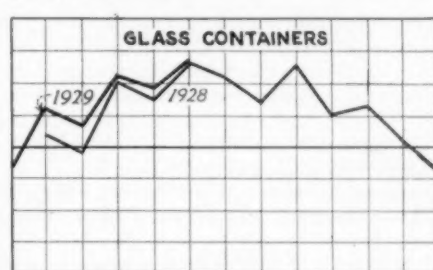
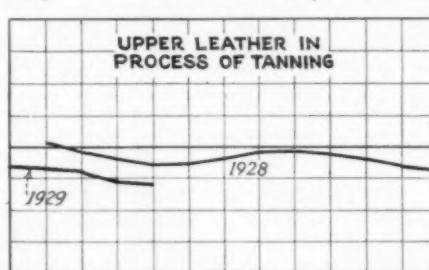
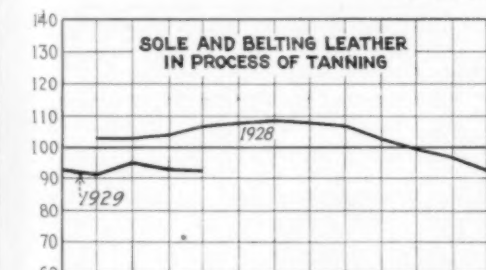
Domestic Production		January	February	March	April	May	Total for 5 Months
Acetate of lime.....	1928—1,000 lb.	12,519	11,718	13,022	11,693	10,987	59,939
	1929—1,000 lb.	11,687	11,266	12,082	11,795	12,446	59,276
Alcohol, ethyl.....	1928—1,000 wine gal.	13,050	11,220	11,050	11,784	11,043	58,147
	1929—1,000 wine gal.	15,282	13,830	14,858	14,709	15,216	73,895
Arsenic, crude.....	1928—ton	1,158	1,600	1,076	1,098	1,225	6,157
	1929—ton	1,136	1,262	1,307	1,382	1,888	6,975
Arsenic, refined.....	1928—ton	827	668	688	669	713	3,565
	1929—ton	913	900	945	836	779	4,573
Automobiles							
Passenger cars.....	1928—no	205,142	290,689	371,150	364,265	375,356	1,606,602
	1929—no	347,382	405,708	513,266	537,225	516,055	2,319,636
Trucks.....	1928—no	26,082	32,645	41,493	45,227	49,920	195,367
	1929—no	51,590	58,536	69,748	82,420	86,596	348,890
Byproduct coke.....	1928—1,000 ton	3,897	2,233	4,065	3,925	4,084	18,204
	1929—1,000 ton	4,360	4,090	4,613	4,457	4,664	22,184
Explosives.....	1928—1,000 lb.	29,607	31,895	30,001	32,153	32,850	156,506
	1929—1,000 lb.	33,596	35,392	34,485	36,077	37,235	176,785
Glass containers.....	1928—1,000 gross	2,207	2,085	2,570	2,421	2,688	11,971
	1929—1,000 gross	2,367	2,261	2,574	2,519	2,683	12,404
Glass, plate.....	1928—1,000 sq. ft.	8,205	10,093	11,951	10,560	10,224	51,033
	1929—1,000 sq. ft.	11,426	11,289	13,144	12,555	12,782	61,196
Methanol, crude.....	1928—gal.	699,551	642,855	707,460	657,253	609,604	3,316,723
	1929—gal.	684,766	676,672	714,266	732,204	730,055	3,537,963
Methanol, refined.....	1928—gal.	496,073	390,099	442,023	468,446	557,780	2,354,421
	1929—gal.	494,501	449,800	494,435	502,010	423,244	2,363,990
Petroleum, refined.....	1928—1,000 bbl.	68,193	65,601	72,428	72,988	77,311	356,521
	1929—1,000 bbl.	78,825	72,031	80,708	80,459		
Superphosphate.....	1928—ton	358,008	345,040	352,691	355,614	284,948	1,696,301
	1929—ton	370,231	307,300	282,504	357,787	346,766	1,664,588
Wood pulp, chemical.....	1928—ton	209,106	209,820	228,692	210,780	222,924	1,081,322
	1929—ton	236,636	213,582	231,836	233,630	241,314	1,156,998
Resin, wood.....	1928—bbl.	29,200	32,792	35,148	34,831	36,036	168,007
	1929—bbl.	37,765	33,152	37,361	36,150	37,708	182,136
Turpentine, wood.....	1928—bbl.	5,711	5,645	6,647	6,052	6,350	30,405
	1929—bbl.	7,347	6,436	7,059	6,917	6,855	34,614
Pine oil.....	1928—gal.	198,646	237,953	259,079	240,845	248,606	1,185,129
	1929—gal.	238,703	204,700	235,445	212,720	219,304	1,110,882
Domestic Consumption							
Wool, grease equivalent.....	1928—1,000 lb.	45,087	48,324	46,757	38,855	43,911	222,934
	1929—1,000 lb.	54,031	47,963	48,656	49,205	48,705	248,560
Cotton.....	1928—bales	586,142	572,875	581,325	524,765	577,384	2,842,491
	1929—bales	668,389	598,098	632,808	631,710	668,229	3,199,234
Silk.....	1928—bales	52,420	50,679	52,011	41,258	46,367	242,735
	1929—bales	57,349	46,228	49,878	53,855	49,121	256,431
Fertilizer, in South.....	1928—ton	626,560	1,113,569	2,185,435	862,878	185,025	4,973,467
	1929—ton	450,600	817,489	2,118,688	1,242,330	219,763	4,848,870
Cottonseed oil.....	1928—bbl.	267,310	274,137	372,600	279,680	244,300	1,438,027
	1929—bbl.	315,839	279,080	273,000	288,900	298,000	1,454,819



# ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



Productive activity based on electrical consumption, Electrical World



# MARKET CONDITIONS and PRICE TRENDS

## Agreement Among Foreign Producers of Nitrogen

Anglo-German-Chilean Nitrogen Cartel  
Has Widespread Market Influence

**M**OST important among recent market developments was the announcement early in the month to the effect that a working agreement had been ratified by prominent factors in the sodium nitrate trade in Chile and producers of nitrogen in England and Germany. Details of this agreement were received in a communication from our commercial attaché at Berlin which stated that the I. G. Farbenindustrie, world's largest producer of nitrogen, has announced that a sales agreement has been reached between the Chilean Minister of Finance, representing the producers of nitrate of soda in Chile, the Imperial Chemical Industries, Ltd., of England, and the German Dye Trust.

The new nitrogen cartel will endeavor to promote the use of nitrogen in agriculture throughout the world, exclusive of the United States, through the medium of a joint advertising campaign.

Coincident with the announcement of the new Anglo-German-Chilean agreement the German Nitrogen Syndicate has named lower prices for the home market effective July 1, 1929. Details of the price policy for world markets have not been received in the Department of Commerce. Reports current in Paris indicate that the new cartel will fix a scale of prices which may vary in different countries.

The new schedule of ammonium sulphate prices of the German Nitrogen Syndicate shows a reduction of 0.05 mark per kilo of fixed nitrogen content. The price during the past two years has ranged from 0.85 mark at the beginning of the season in July with gradual increases to 0.95 mark during the heavy buying season, February to June. Ammonium sulphate-nitrate, which heretofore sold at the same price as ammonium sulphate, based on the nitrogen content, has been reduced 0.02 mark.

Synthetic sodium nitrate will be offered at 1.13 marks per kilo of nitrogen content as compared with 1.23 marks per kilo at the beginning of the last season. Calcium nitrate was also reduced to 1.03-1.07 as compared with a flat price of 1.13 last season. Nitrophoska, the complete chemical fertilizer, which is produced in several grades of varying proportions of plant food, has been reduced 5 marks per metric ton.

### Flaxseed Reports Shows Small Crop

On July 10 the Crop Reporting Board of the Department of Agriculture issued its first report on the 1929 crop of flaxseed. The report proved disappointing inasmuch as it revealed an unusually poor condition and indicated a very low yield per acre. The report follows, with comparison for the July report of 1928:

	July 1 1928	July 1 1929
Condition .....	76.8	71.5
Acres .....	2,831,000	3,092,000
Yield per acre....	7.6	6.4
Estimated production .....	21,500,000	19,900,000

**A**NOTHER market development of the last month also had its origin abroad. This consisted in a report that French and Belgian salt cake (sodium sulphate) producers are about to enter an international convention, so far confined to the Germans and British, to allocate export markets. The combination would represent about 590,000 metric tons of product, divided as follows: Germany, 290,000 tons; Great Britain, 150,000 tons; Belgium, 80,000 tons, and France, 70,000 tons.

The Anglo-German agreement on salt cake markets has been in effect since 1925 to run to 1930, but this will more likely be extended to 1935. It reserves British markets to England; German, Czech, and Austrian markets to Germany, with a 40:60 (English-German) division on all other export markets.

The importance of this on domestic markets rests on the fact that importations of salt cake into this country have been increasing in recent years with Belgium and Germany as the principal contributing countries.

For the six months December to May, 1928-29, imports of ammonia fertilizer compounds into the United States equaled 29,000 long tons. During the same period the exports of ammonium sulphate were 60,000 tons, according to official reports for this active fertilizer season. Students of nitrogen and fertilizer statistics, noting these facts, raise the question as to how long it will be before the imports of ammonia will equal the exports and thus the United States again find itself as a nitrogen

buyer rather than a nitrogen seller in world markets.

Taking all fertilizer materials together the imports for the six months in question were 5 per cent less than during the corresponding six months the year before. The exports, on the other hand, increased by about 8 per cent as compared with the preceding season.

New business in chemicals has shown a tendency toward contraction in the last month but withdrawals against contract holdings have held above the seasonal average. Some specialties have received increased attention but in general new orders bear no special significance. Weevil activity in cotton-producing states has stirred up interest in the market for calcium arsenate but stocks are ample and consuming demand does not appear to be running ahead of that reported last season.

Acetate of soda may be cited as one of the chemicals for which good inquiry has been felt and greater importance is given to it because production has not been running heavy and the scarcity of spot supplies has enabled holders to exact premiums for prompt shipment.

Mineral acids and alkalis continue to move into consumption in a large way and while a slowing up was reported since the first of this month the six-month period ended June 30 was highly satisfactory.

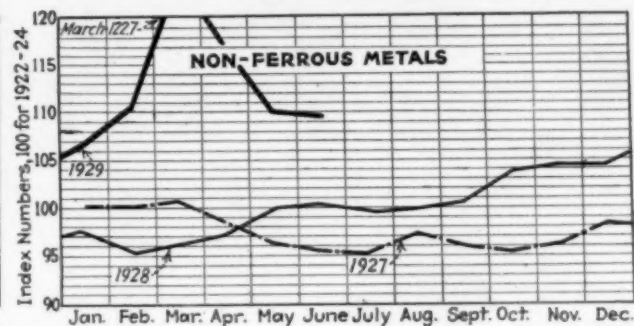
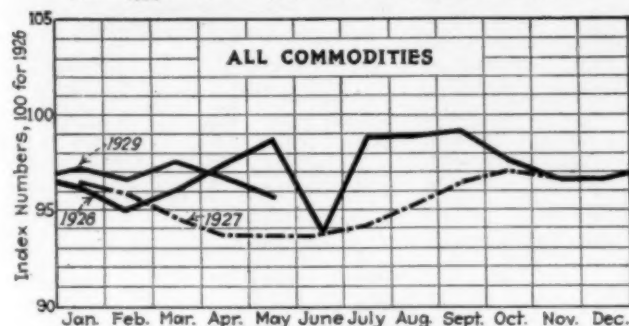
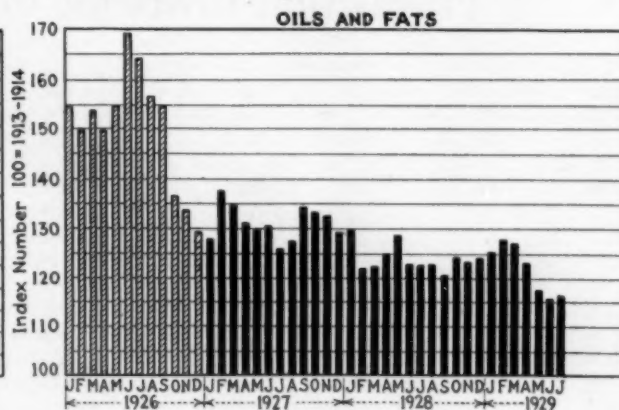
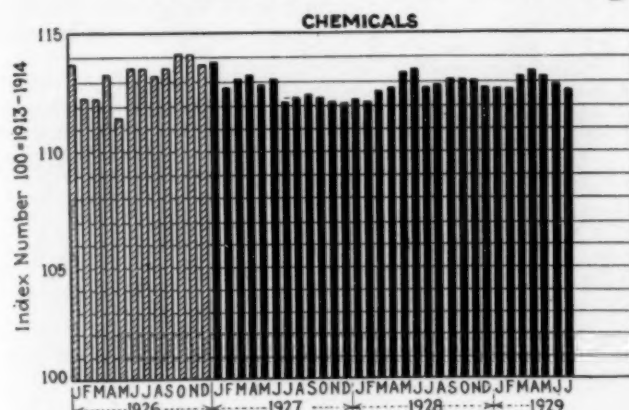
Production of coal-tar chemicals is reported to have been maintained on a very large scale and this is borne out by production figures for byproduct coke. Benzol is moving steadily from producing points and the increased output has not caused any accumulations. Phenol also is finding a good consuming outlet and the greater part of production is absorbed in filling contract orders. Toluol and solvent naphtha are in a similar position with no large reserve stocks in sellers' possession.

Domestic sellers of tartaric acid have found a good outlet and while finding competition from imported material were in a position to hold a major share of the business.

Vegetable oils are moving in a routine way with crop conditions looming up as important in the case of cottonseed and linseed oils. Coconut oil has sold at low prices but recent advices from Manila report a steady tone for copra and also state that native mills are cutting down production of oil so that it is probable surplus stocks will be reduced. The menhaden fishing is now well under way and sales of crude menhaden oil have been made at 42c. and 43c. per gallon f.o.b. producing points. At the close of the period sellers were firmer in their views and asking prices were as high as 45c. per gallon.



## CHEM. & MET. *Weighted Indexes of PRICES*



U. S. Dep't of Labor

Engineering & Mining Journal

### Fertilizer Chemicals Show Easier Price Trend

PRICE levels for chemicals, as measured by the weighted index number, were again lowered in the last month. Fertilizer chemicals were responsible for the downward revision. The international cartel formed by producers of nitrogen was followed by a lowering in prices for sulphate of ammonia, nitrate of soda, and other nitrogen-bearing compounds. Opinion for some time had inclined to the view that increased production of nitrogen by air fixation would result in lower prices with probable competition from Chilean nitrate of soda. While the present arrangement modifies, if it does not exclude, this competition it is equally effective as a price factor since the plan calls for a general reduction in prices in order to enlarge the consuming markets of the world to a point where the proposed nitrogen output

will be absorbed. Hence the announcement of reduced sales prices may be regarded as more than a temporary expedient.

In the market for chemicals in general, the factors in favor of a steady price structure are the continuance of large consumption as a result of activity in manufacturing lines and the lessening of competition through amalgamations and mergers among producers of chemicals. Foreign competition in the future also may be curtailed when the new tariff schedule has been completed and becomes operative.

Increased call for calcium arsenate, copper sulphate, and similar products has created a firmer price situation but supplies are large enough to take care of demands and advances in sales schedules are not looked for. This also applies to sodium acetate although the latter has brought premiums in the spot market and is expected to maintain a strong position until supplies are available in larger volume.

Mineral acids have been strongly held for months and there is no present indication of any change. Production has outstripped that for the corresponding period of last year but consumption has shown an equal extension, and with raw materials on a steady basis, price fluctuations are improbable.

Among the metal salts, the tin products are most susceptible to changes in the metal market, and with tin in a

strong position, the immediate outlook is for higher prices for the tin salts. Lead has developed an easier tone but not enough to affect the status of the lead salts.

IN THE vegetable oil group it is pointed out that coconut oil has been selling at very low prices and while stocks are large, the market looks favorable for covering at least part of future requirements on the theory that the oil is a buy at prevailing figures. Linseed oil is in a position where lower prices might be expected as time draws nearer the harvesting of a new flaxseed crop. This is more than offset, however, by the recent increase in import duty on seed and any declines in the seed and oil markets will be but temporary with higher prices almost sure to prevail over the greater part of the coming fiscal year. The progress of the cotton crop is of importance in the market for cottonseed oil with moderate declines probable in new crop options if weather conditions remain favorable.

#### Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	112.71
Last month	112.90
July, 1928	112.80
July, 1927	112.23

Lower prices for fertilizer chemicals, especially sulphate of ammonia and nitrate of soda, represent the outstanding development of the market from a price standpoint. Steady prices ruled for most other chemicals with phenol selling at advanced levels.

#### Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	116.64
Last month	115.82
July, 1928	122.63
July, 1927	126.20

Rising prices for linseed oil were the most important factor in raising the weighted index number. Coconut, palm, corn, and China wood oils were easier in tone. Crude menhaden oil attained prominence because fishing operations have given a new supply.

## Higher Duty for Linseed Increases Production Costs for Oil

UNDER presidential proclamation, the import duty on linseed, or flaxseed, was increased from 40c. per bushel to 56c. per bushel, the higher duty becoming effective on June 13. As a large part of our linseed supply comes from the Argentine, it is evident that any increase in the cost of the raw material must find reflection in the cost of linseed oil. The Tariff Commission in reporting its investigation into production costs has issued a report in which the members of the commission show an equally divided opinion relative to the compensatory duty which linseed oil should carry in order to equalize production costs in this country and abroad.

Three of the commissioners advocated a duty of 3.9c. per pound and three deemed that a customs protection of 3.7c. per pound would be sufficient.

The Netherlands is the principal competing country and the tariff investigation centered in a compilation of production cost data for that country and for the United States.

THE commission reported that the weighted average cost of production of linseed oil in the United States for the two years 1925 and 1926, including adjustments for the change in the duty upon flaxseed from 40c. per bushel to 56c. per bushel, and including transportation to New York City, (a) weighted by the production of all the mills included in the scope of the investigation, is 12.43c. per pound; (b) weighted by the production of domestic mills included in the scope of the investigation that are located in Chicago and Milwaukee and east thereof, is 12.25c. per pound; (c) weighted by the actual shipments from the mills included in the scope of the investigation which shipped to New York City during the period covered by the investigation, is 12.09c. per pound. The cost of production of linseed oil produced in the Netherlands, including transportation to New York City, is 8.55c. per pound.

During the last calendar year, imports of linseed oil amounted to 173,447 lb., valued at \$14,056. While the higher import duty on seed might advance oil prices to a point where importations might be invited unless a compensatory duty on oil held them in check, it is evident that the duty on seed has a far wider effect than has the duty on oil. That the farmers in the Northwest will obtain higher prices for seed under a higher protective tariff is self evident. That this will influence them to sow a larger acreage to flax is not so apparent when conditions surrounding the planting and raising of this crop are taken into consideration.

Crushers are confronted with two possibilities: (1) that future domestic flaxseed crops will be large enough to take care of home consuming requirements; (2) that the domestic flaxseed

crop—as it has for many years—will fall short of filling needs and will make importations of seed necessary. Under the first contingency no drawbacks will be possible on exports of oilcake since the latter will have been produced entirely from domestic seed. Our production of oilcake is much larger than can be consumed in our own markets, as may be inferred from the fact that last year exports reached a total of 547,474,712 lb., valued at \$13,086,357.

IN ORDER to maintain export outlets for our surplus production of oilcake, prices must be held on a parity with those prevailing in European markets. This can be realized only by writing off to oil a proportionately higher percentage of production costs. Hence the advance in linseed oil prices must be relatively higher than that represented by the increase in the cost of seed.

Under normal conditions the history of the linseed oil trade reveals that high prices for oil not only have the effect of cutting down the volume of consumption but also encourage the use of substitutes.

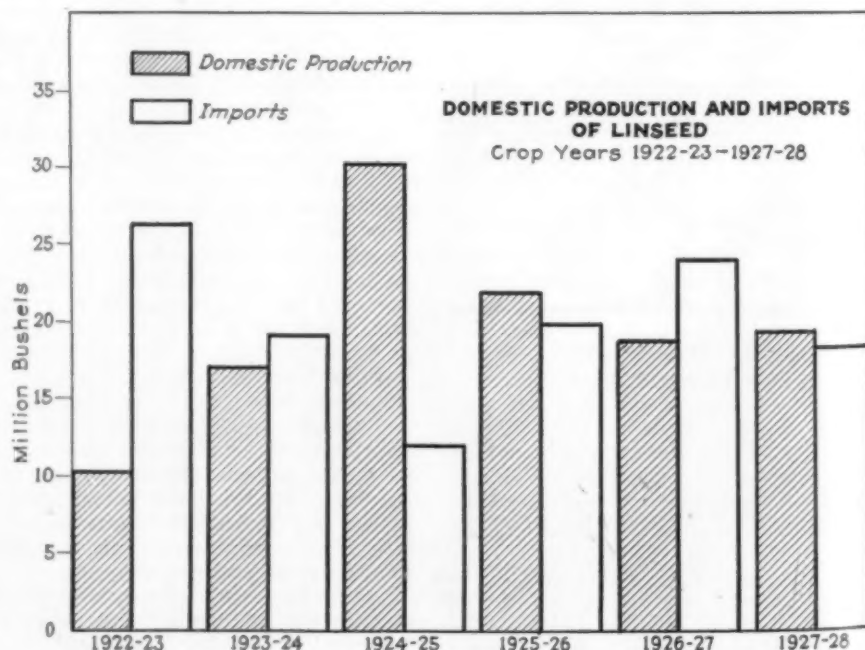
The second possibility confronting crushers would place them in competition with European buyers in the seed markets of the Argentine and the advantage of a drawback on exports of oilcake made from imported seed would depend on the prevailing prices for seed in foreign markets. But in any case the drawback would not compensate for the free entry of seed into European crushing centers and our exporters of oilcake would be at a price disadvantage in meeting competition.

Domestic Production and Imports of Linseed—  
Crop Years 1922-1928

Crop Year	Domestic Production Bu.	Imports Bu.	Imports Per Cent of Total Supply
1922-23	10,375,000	26,236,000	71
1923-24	17,060,000	19,011,000	52
1924-25	30,173,000	12,010,000	28
1925-26	22,018,000	19,971,000	47
1926-27	18,799,000	24,093,000	56
1927-28	25,847,000	18,160,000	41

Linseed Oil, Costs of Production for the United States and the Netherlands, 1925, 1926, and 1925-26

	1925		1926		1925-1926	
	United States	Netherlands	United States	Netherlands	United States	Netherlands
Cost f.o.b. mill.....	13.03	9.49	11.09	7.12	12.06	8.15
Transportation charges to New York City weighted by:						
Production of all domestic mills included in the scope of the investigation.....	.40	.44	.35	.29	.37	.40
Production of domestic mills including mills of Chicago and Milwaukee and east thereof.....	.21	.44	.17	.29	.19	.40
Actual shipments.....	.02	.44	.04	.29	.03	.40
Cost including transportation charges to New York City weighted by:						
Production of all domestic mills included in the scope of the investigation.....	13.43	9.93	11.44	7.41	12.43	8.55
Production of domestic mills including mills of Chicago and Milwaukee and east thereof.....	13.24	9.93	11.26	7.41	12.25	8.55
Actual shipments.....	13.05	9.93	11.13	7.41	12.09	8.55
Amount by which the cost of production in the United States exceeds the cost of production in the Netherlands, including transportation charges to New York City weighted by:						
Production of all domestic mills included in the scope of the investigation.....	3.50		4.03		3.88	
Production of domestic mills including mills of Chicago and Milwaukee and east thereof.....	3.31		3.85		3.70	
Actual shipments.....	3.12		3.72		3.54	
Comparison of costs of production based upon a duty of 56c. per bu. on flaxseed.						





# MARKET APPRAISAL OF CHEMICAL INDUSTRY

Corn Products Refining Company declared extra dividend of 50 cents and quarterly dividend of 75 cents on common, placing stock on regular annual basis of \$3 against \$2 formerly.

Net income of Wesson Oil & Snow-drift Company, Inc., and subsidiaries for nine months ended May 31, 1929, was \$1,335,554 after depreciation and federal taxes, against \$1,955,538 in corresponding period of preceding year.

Minority interest in Lazote, Inc., consisting of 22,500 shares, has been acquired by E. I. duPont de Nemours & Company, through the issuance of 10,713 shares of duPont common stock. This will give duPont complete ownership of Lazote.

First annual report of Associated Dyeing & Printing Corporation, covering year ended May 31, 1929, shows net profit of \$132,432 after depreciation, interest, federal taxes, etc., equivalent to 81 cents a share on 163,020 no-par shares of capital stock.

Freeport Texas Company reports for quarter ended May 31, 1929, net income of \$1,136,482 after expenses and reserves for depreciation and taxes, equivalent to \$1.55 a share earned on 729,844 shares of no-par stock. This compares with \$737,037 or \$1.01 a share in preceding quarter and \$866,271 or \$1.19 a share in quarter ended May 31, 1928.

Liquid Carbonic Company reports for eight months ended May 31, 1929, net profit of \$671,563 after charges and taxes, equivalent to \$2.50 a share earned on 268,424 shares of no-par stock. This compares with net profit of \$355,580 in same period of previous year, equal to \$1.32 a share.

Statement of American I. G. Chemical Corporation, filed with N. Y. Stock Exchange, as of May 31, 1929, shows total assets of \$61,407,177 and paid-in surplus of \$17,771,850.

Special stockholders' meeting of Libby Owens Sheet Glass Company has been set for July 19, when plans for common stock split four-for-one, change from \$25 to no-par value, and shortened name for company will be up for approval.

Monsanto Chemical Works stockholders have approved increase in authorized common to 500,000 shares and a two-for-one stock split-up. The management previously announced its intention to place the new stock on an annual dividend basis of \$2.10 in cash and 6 per cent in stock.

Archer - Daniels - Midland Company, for nine months ended June 1, 1929, reports net profit of \$950,382 after depreciation, federal taxes, etc., equivalent after 7 per cent preferred dividend requirements, to \$1.54 a share earned on 480,852 shares of no-par common stock.

Price Range Since Jan. 1		Stock	Price Range in June			
High	Low		June 1	High	Low	June 29
153½	95½	Air Reduction.....	127½	153½	125½	145½
11½	4½	Ajax Rubber.....	4½	6½	4½	6
328	241	Allied Chemical.....	277	328	277	325½
125	120½	Allied Chemical, pf.....	121	122½	120½	120½
23½	10½	Am. Ag. Chemical.....	10½	13½	10½	11½
73½	40½	Am. Ag. Chemical, pf.....	41½	48½	41	45
80	39½	American Cyanamid B.....	40½	56½	40	53½
10	6½	American Hide & Leather.....	8½	7½		
81½	50	American Metals.....	54½	65	54½	64
40½	25	Am. Solvents & Chemical.....	29½	25	25	27
45½	33	Anglo-Chile Nitrate.....	38½	42½	37½	39½
49½	29	Archer-Daniels-Midland.....	31½	33½	29	29½
27½	13	Assoe. Dyeing & Printing.....	19½	19½	14	17½
115	90	Atlas Powder.....		109½	92	100
29½	20	Beacon Oil.....		29½	24½	28½
101	73	Beechnut Packing.....		86	77½	85½
89½	78½	Bon Ami, A.....	84	85½	82½	83
121½	84½	Bristol-Myers.....	91	121½	91	118½
30	25	California Petroleum.....		27½	25	
57½	31	Celanese.....		39½	31	32
122	95	Celanese, pf.....		104½	95	
28½	16½	Certainfeed.....	25	27	23½	23½
50	37½	Chickasha Cotton Oil.....	38½	40	37½	39
80½	63	Colgate-Palmolive-Peet.....	66	67½	65	65½
446½	225½	Commercial Solvents.....	335½	446½	334½	444½
102½	82	Corn Products.....	89	102½	89	99½
69½	42½	Davison Chemical.....	44	53½	43½	53½
64½	43½	Devco & Raynolds.....	45	52½	43½	51½
115½	112	Devco & Raynolds, pf.....	115	115	115	
198½	155½	Du Pont.....	158½	187½	157	185
119	115½	Du Pont, 6 pc db.....	115½	116½	115½	115½
194½	168	Eastman Kodak.....	171½	184½	169	181½
309	220½	Firestone Tire.....	279½	279½	268½	268½
20½	7½	Fisk Rubber.....		9½	7½	8½
87½	65½	Fleischmann Co.....	75½	87½	74	83
54½	37½	Freeport Texas.....	38½	48½	37½	47½
62½	36½	Glidden Co.....	46	61½	45½	61½
106½	101½	Glidden Co., pf.....	102	103½	101½	
82	53½	Gold Dust.....		54½	54½	61½
105½	73	Goodrich Co.....	74½	82½	73½	81½
109	70½	Houston Oil.....		84½	72½	
135	74	Industrial Rayon.....		98½	81	92
17½	8½	Int. Ag. Chemical.....	8½	8½	8½	8½
88½	67	Int. Ag. Chemical, pf.....	68½	69	67	
35½	25	International Paper.....		68½	67	
90½	55½	International Salt.....	70	75	70	73
24	11	Kelly-Springfield.....	14	16½	13½	15½
25	10	Lee Rubber & Tire.....	13½	16½	13	14
68½	50½	Lehn & Fink.....	51½	55	50½	52
220½	148	Libby-Owens.....	162½	202½	148	185
113½	71½	Liquid Carbonic.....	77½	91½	77½	91½
58½	42½	Mathieson Alkali.....	45½	58½	45½	56½
160	125½	Monsanto Chemical.....		154	150½	
58	33	Nat'l Dist. Products.....	43½	58	43½	48½
173	132	National Lead.....	153	153	142	151
87½	75½	New Jersey Zinc.....	80½	80½	77½	79
75½	64½	Ohio Oil.....	70½	75½	70½	72
84	78	Owens Bottle.....	78½	83½	78	79
47	36½	Phillips Petroleum.....	38½	40½	36½	37½
76½	64	Pittsburgh Plate Glass.....		66½	64	65
85	63	Pratt & Lambert.....		72	67½	71
30½	23½	Pure Oil.....	27½	29½	26½	26½
48½	23½	Sherwin-Williams.....		93½	90	
45	35½	Silica-Gel.....		39½	35	38½
46½	32½	Sinclair Oil.....	38½	40½	35½	36½
81½	64	Skelly Oil.....	39½	44	38½	41
62½	48	Standard Oil, Cal.....	73½	78½	71½	72½
45½	38	Standard Oil, N. J.....	57	59½	55½	57½
9½	4½	Standard Oil, N. Y.....	39½	41½	38½	39½
68½	57	Standard Plate Glass.....		5	5	
18	14	Sun Oil.....	61	65½	61	65
20½	16	Swan & Finch.....		17	17	
68½	57½	Tennessee Copper & Chemical.....	17	18½	17	17½
85½	69½	Texas Corporation.....	62½	64½	60½	62½
40	27½	Texas Gulf Sulphur.....	71½	74½	69½	70
550	305	Tidewater Oil.....		40	34½	35
103½	75½	Tubize Silk.....		370	305	325
54½	46	Union Carbide.....	81½	103½	81½	102½
53	35½	Union Oil, Cal.....	47½	49½	47½	47½
187	128	United Piece Dye.....		40½	35	37½
35½	19½	U. S. Ind. Alcohol.....	157½	187	157½	179½
65	42	U. S. Leather.....	21½	25½	21½	23
133½	105½	U. S. Rubber.....	47½	53½	46½	53½
116½	68	Vacuum Oil.....	117½	120½	113	117½
109	82	Vanadium Corp.....	72½	92½	70½	89½
24½	9½	Vick Chemical.....	99½	101½	87½	91
		Va-Ca Chemical.....	11	14½	11	12½
		Va-Ca Chemical, pf.....	90	90½	88	
48	35	Wesson Oil.....	38½	40½	35	35½
13½	7	Wilson & Co.....	7½	9½	7½	8

# CURRENT PRICES

## in the NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 15.

### Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums.....lb.	\$0.14-\$0.15	\$0.14-\$0.15	\$0.14-\$0.15
Acid, acetic, 28%, bbl.....cwt.	3.88-4.03	3.88-4.03	3.38-3.63
Boric, bbl.....lb.	.054-.06	.061-.07	.061-.07
Citric, keg.....lb.	.46-.47	.46-.47	.46-.47
Formic, bbl.....lb.	.101-.11	.11-.12	.11-.12
Gallio, tech., bbl.....lb.	.50-.55	.50-.55	.50-.55
Hydrofluoric 30% carb.....lb.	.06-.07	.06-.07	.06-.07
Lactic, 44%, tech., light, bbl.....lb.	.11-.114	.114-.12	.13-.134
22%, tech., light, bbl.....lb.	.054-.06	.054-.06	.06-.07
Muriatic, 18%, tanks.....cwt.	.85-.90	.85-.90	.85-.90
Nitric, 36%, carboys.....lb.	.05-.054	.05-.054	.05-.054
Oleum, tanks, wks.....ton	18.00-20.00	18.00-20.00	18.00-20.00
Oxalic, crystals, bbl.....lb.	.11-.114	.11-.114	.11-.114
Phosphoric, tech., c'ys.....lb.	.084-.09	.084-.09	.084-.09
Sulphuric, 60%, tanks.....ton	11.00-11.50	11.00-11.50	11.00-11.50
Tannic, tech., bbl.....lb.	.35-.40	.35-.40	.35-.40
Tartaric, powd., bbl.....lb.	.38-.39	.38-.39	.38-.39
Tungstic, bbl.....lb.	1.30-1.40	1.30-1.40	1.00-1.20
Alcohol, ethyl, 190 p'f., bbl.....gal.	2.684-2.71	2.684-2.71	2.684-2.71
Alcohol, Butyl, dr.....lb.	.164-.17	.171-.18	.184-.19
Denatured, 190 proof			
No. 1 special dr.....gal.	.50-.50	.50-.50	.45-.45
No. 3, 188 proof, dr.....gal.	.50-.50	.50-.50	.44-.44
Alum, ammonia, lump, bbl.....lb.	.034-.04	.034-.04	.034-.04
Chrome, bbl.....lb.	.054-.054	.054-.054	.054-.06
Potash, lump, bbl.....lb.	.03-.034	.03-.034	.024-.034
Aluminum sulphate, com., bags.....cwt.	1.40-1.45	1.40-1.45	1.40-1.45
Iron free, bag.....cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Aqua ammonia, 26%, drums.....lb.	.03-.04	.03-.04	.03-.04
Ammonia, anhydrous, cyl.....lb.	.14-.14	.14-.14	.134-.134
Ammonium carbonate, powd., tech., caaks.....lb.	.12-.13	.12-.13	.104-.14
Sulphate, wks.....cwt.	2.20-.25	2.25-.25	2.35-.25
Amylacetate tech., drums.....gal.	1.75-2.00	1.75-2.00	1.75-2.00
Antimony Oxide, bbl.....lb.	.104-.11	.11-.12	.12-.13
Arsenic, white, powd., bbl.....lb.	.04-.044	.04-.044	.04-.044
Hel, powd., keg.....lb.	.09-.10	.09-.10	.09-.10
Barium carbonate, bbl.....ton	58.00-60.00	58.00-60.00	57.50-60.00
Chloride, bbl.....ton	65.00-67.00	65.00-67.00	57.00-58.00
Nitrate, caak.....lb.	.084-.09	.084-.09	.08-.084
Blanc fixe, dry, bbl.....lb.	.034-.04	.034-.04	.04-.044
Bleaching powder, f.o.b., wks., drums.....cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Borax, bbl.....lb.	.024-.03	.024-.03	.024-.03
Boroline, es.....lb.	.45-.47	.45-.47	.45-.47
Calcium acetate, bags.....cwt.	4.50-.50	4.50-.50	3.50-.50
Arsenate, dr.....lb.	.064-.07	.064-.07	.064-.07
Carbide, drums.....lb.	.054-.06	.054-.06	.054-.06
Chloride, fused, dr, wks.....ton	20.00-.084	20.00-.084	20.00-.074
Phosphate, bbl.....lb.	.08-.084	.08-.084	.08-.084
Carbon bisulphide, drums.....lb.	.05-.06	.05-.06	.05-.06
Tetrachloride drums.....lb.	.064-.07	.064-.07	.064-.07
Chlorine, liquid, tanks, wks.....lb.	.03-.034	.03-.034	.034-.044
Cylinders.....lb.	.03-.08	.03-.08	.034-.084
Cobalt oxide, caak.....lb.	2.10-2.20	2.10-2.20	2.10-2.25
Copperas, bags, f.o.b. wks.....ton	15.00-16.00	15.00-16.00	16.00-17.00
Copper carbonate, bbl.....lb.	.19-.21	.19-.21	.164-.174
Cyanide, tech., bbl.....lb.	.49-.50	.49-.50	.49-.50
Sulphate, bbl.....cwt.	6.00-6.10	6.00-6.10	5.30-5.50
Cream of tartar, bbl.....lb.	.274-.28	.274-.28	.264-.27
Diethylene glycol, dr.....lb.	.10-.15	.10-.15	.10-.15
Epsom salt, dom., tech., bbl.....cwt.	1.75-2.15	1.75-2.00	1.75-2.00
Imp., tech., bags.....cwt.	1.15-1.25	1.15-1.25	1.15-1.25
Ethyl acetate, drums.....gal.	1.03-.10	1.03-.10	.83-.08
Formaldehyde, 40%, bbl.....lb.	.094-.10	.094-.10	.074-.08
Furfural, dr.....lb.	.13-.174	.15-.174	.15-.17
Fusel oil, crude, drums.....gal.	1.30-1.40	1.30-1.40	1.30-1.40
Refined, dr.....gal.	1.90-2.00	1.90-2.00	2.50-3.00
Glauber salt, bags.....cwt.	1.10-1.20	1.10-1.20	1.00-1.10
Glycerine, e.p., drums, extra.....lb.	.14-.144	.144-.15	.15-.16
Lead:			
White, basic carbonate, dry, caaks.....lb.	.09-.09	.09-.09	.084-.084
White, basic sulphate, sek.....lb.	.084-.084	.084-.084	.074-.074
Red, dry, sek.....lb.	.10-.104	.104-.104	.094-.094
Lead acetate, white crys., bbl.....lb.	.14-.144	.14-.144	.13-.134
Lead arsenate, powd., bbl.....lb.	.13-.14	.13-.14	.12-.13
Lime, chem., bulk.....ton	8.50-.850	8.50-.850	8.50-.850
Litharge, powd., sek.....lb.	.094-.094	.094-.094	.084-.084
Lithopone, bags.....lb.	.054-.06	.054-.06	.054-.064
Magnesium carb., tech., bags.....lb.	.06-.064	.06-.064	.064-.07
Methanol, 95%, dr.....gal.	.55-.55	.55-.55	.48-.48
97%, dr.....gal.	.55-.55	.55-.55	.48-.48
N'kel salt, double, bbl.....lb.	.13-.134	.13-.134	.10-.10
Single, bbl.....lb.	.13-.134	.13-.134	.104-.114

	Current Price	Last Month	Last Year
Orange mineral, caak.....lb.	\$0.124-.57	\$0.124-.57	\$0.114-.65
Phosphorus, red, caak.....lb.	.55-.57	.55-.57	.62-.33
Yellow, caak.....lb.	.32-.33	.32-.34	.32-.33
Potassium bichromate, caak.....lb.	.084-.084	.084-.084	.084-.084
Carbonate, 80-85%, calc., caak.....lb.	.054-.06	.054-.06	.054-.06
Chlorate, powd.....lb.	.074-.084	.074-.084	.08-.084
Cyanide, es.....lb.	.52-.55	.52-.55	.51-.53
First sort, caak.....lb.	.084-.09	.084-.09	.084-.09
Hydroxide (caustic potash) dr.....lb.	.074-.074	.074-.074	.074-.074
Muriate, 80% bgs.....ton	36.75-.36.75	36.75-.36.75	36.40-.36.40
Nitrate, bbl.....lb.	.06-.064	.06-.064	.06-.074
Permanganate, drums.....lb.	.16-.164	.16-.164	.15-.16
Prussiate, yellow, caak.....lb.	.19-.194	.19-.194	.18-.19
Sal ammoniac, white, caak.....lb.	.046-.05	.046-.05	.047-.05
Salsoda, bbl.....cwt.	.90-.95	.90-.95	.90-.95
Salt cake, bulk.....ton	16.00-18.00	16.00-18.00	14.00-17.00
Soda ash, light, 58%, bags, contract.....cwt.	1.32-.1.32	1.32-.1.32	1.32-.1.32
Dense, bags.....cwt.	1.35-.1.35	1.35-.1.35	.35-.35
Soda, caustic, 76%, solid, drums, contract.....cwt.	2.90-3.00	2.90-3.00	.00-3.10
Acetate, works, bbl.....lb.	.064-.07	.05-.054	.054-.06
Bicarbonate, bbl.....cwt.	2.00-2.25	2.00-2.25	2.00-2.25
Bichromate, caak.....lb.	.07-.074	.07-.074	.07-.074
Bisulphate, bulk.....ton	12.00-15.00	12.00-15.00	3.00-3.50
Bisulphite, bbl.....lb.	.034-.034	.034-.034	.034-.034
Chlorate, keg.....lb.	.07-.074	.07-.074	.064-.064
Chloride, tech.....ton	12.00-14.75	12.00-14.75	12.00-14.00
Cyanide, caak, dom.....lb.	.18-.22	.18-.22	.18-.22
Fluoride, bbl.....lb.	.084-.094	.084-.094	.084-.09
Hyposulphite, bbl.....lb.	2.50-3.00	2.50-3.00	2.50-3.00
Nitrate, bags.....cwt.	2.15-.2.15	2.15-.2.15	2.224-.2.224
Nitrite, caak.....lb.	.074-.08	.074-.08	.074-.08
Phosphate, dibasic, bbl.....lb.	.034-.034	.034-.034	.034-.034
Prussiate, yel. drums.....lb.	.114-.12	.114-.12	.114-.12
Silicate (30%, drums).....cwt.	.75-1.15	.75-1.15	.75-1.15
Sulphide, fused, 60-62%, dr.....lb.	.024-.034	.024-.03	.034-.04
Sulphite, crys., bbl.....lb.	.024-.03	.024-.03	.024-.03
Strontium nitrate, bbl.....lb.	.09-.094	.09-.094	.09-.094
Sulphur, crude at mine, bulk.....ton	18.00-.18.00	18.00-.18.00	18.00-.18.00
Chloride, dr.....lb.	.04-.05	.04-.05	.04-.05
Dioxide, cyl.....lb.	.09-.10	.09-.10	.09-.10
Flour, bag.....cwt.	1.55-3.00	1.55-3.00	1.55-3.00
Tin bichloride, bbl.....lb.	.144-.144	.144-.144	.144-.144
Oxide, bbl.....lb.	.53-.53	.53-.53	.53-.53
Crystalline, bbl.....lb.	.35-.35	.35-.35	.36-.36
Zinc chloride, gran., bbl.....lb.	.064-.064	.064-.064	.064-.064
Carbonate, bbl.....lb.	.104-.11	.10-.104	.10-.11
Cyanide, dr.....lb.	.40-.41	.40-.41	.40-.41
Dust, bbl.....lb.	.084-.09	.084-.09	.09-.10
Zinc oxide, lead free, bag.....lb.	.064-.064	.064-.064	.064-.064
5% lead sulphate, bags.....lb.	.064-.064	.064-.064	.064-.064
Sulphate, bbl.....cwt.	3.50-3.75	2.75-3.00	2.75-3.00

### Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.....lb.	\$0.134-\$0.14	\$0.134-\$0.14	\$0.134-\$0.14
Chinawood oil, bbl.....lb.	.144-.144	.144-.144	.15-.15
Cocoon oil, Ceylon, tanks, N. Y.....lb.	.064-.064	.064-.064	.084-.084
Corn oil crude, tanks, (f.o.b. mill).....lb.	.074-.074	.08-.08	.084-.084
Cottonseed oil, crude (f.o.b. mill, tanks).....lb.	.074-.074	.08-.08	.08-.08
Linseed oil, raw, ear lota, bbl.....lb.	.113-.113	.104-.104	.110-.110
Palm, Lagos, caaks.....lb.	.074-.074	.074-.074	.074-.074
Niger, caaks.....lb.	.074-.074	.074-.074	.074-.074
Palm Kernel, bbl.....lb.	.084-.084	.074-.074	.094-.094
Peanut oil, crude, tanks (mill).....lb.	.084-.084	.084-.084	.094-.094
Rapeseed oil, refined, bbl.....gal.	.83-.84	.83-.84	.90-.92
Soya bean tank (f.o.b. Coast).....lb.	.084-.084	.084-.084	.094-.094
Sulphur (olive foota), bbl.....lb.	.094-.094	.094-.094	.094-.094
Cod, Newfoundland, bbl.....gal.	.65-.67	.65-.67	.68-.69
Menhaden, light pressed, bbl.....gal.	.70-.72	.70-.72	.62-.64
Crude, tanks (f.o.b. factory).....gal.	.43-.43	.42-.42	.45-.45
Whale, crude, tanks.....gal.	.80-.80	.80-.80	.80-.80
Grease, yellow, loose.....lb.	.064-.064	.064-.064	.074-.074
Oleo stearine.....lb.	.094-.094	.094-.094	.094-.094
Red oil, distilled, d.p. bbl.....lb.	.094-.10	.094-.10	.094-.094
Tallow, extra, loose.....lb.	.074-.074	.07-.07	.08-.08

### Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.....lb.	\$0.60-\$0.65	\$0.60-\$0.65	\$0.60-\$0.62
Refined, bbl.....lb.	.80-.85	.80-.85	.85-.90
Alpha-naphthylamine, bbl.....lb.	.32-.34	.32-.34	.35-.36
Aniline oil, drums, extra.....lb.	.144-.15	.144-.15	.15-.16
Aniline salts, bbl.....lb.	.24-.25	.24-.25	.24-.25
Anthracene, 80%, drums.....lb.	.60-.65	.60-.65	.60-.65



## Coal Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr. lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl. lb.	.67 - .70	.67 - .70	.70 - .72
Benzoic acid, U.S.P., kgs. lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech. dr. lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works. gal.	.23 - .25	.23 - .25	.22 - .23
Beta-naphthol, tech. drums lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr. lb.	.14 - .17	.14 - .17	.18 - .20
Crotylic acid, 97%, dr., wks. gal.	.70 - .73	.73 - .75	.73 - .75
Diethylaniline, dr. lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl. lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoluen. bbl. lb.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr. gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl. lb.	.42 - .43	.42 - .43	.45 - .47
H-acid, bbl. lb.	.60 - .63	.60 - .63	.63 - .65
Naphthalene, flake, bbl. lb.	.044 - .05	.044 - .05	.05 - .06
Nitrobenzene, dr. lb.	.09 - .10	.09 - .10	.08 - .10
Para-nitraniline, bbl. lb.	.55 - .56	.55 - .56	.52 - .53
Para-nitrotoluene, bbl. lb.	.29 - .31	.29 - .31	.28 - .32
Phenol, U.S.P., drums lb.	.13 - .14	.13 - .14	.15 - .17
Picric acid, bbl. lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr. lb.	1.75 - 1.90	1.75 - 1.90	1.35 - 1.50
R-salt, bbl. lb.	.44 - .45	.44 - .45	.47 - .50
Resorcinol, tech. kgs. lb.	1.30 - 1.35	1.30 - 1.35	1.30 - 1.40
Salicylic acid, tech. bbl. lb.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w., tanks. gal.	.30 - .35	.30 - .35	.35 - .35
Tolidine, bbl. lb.	.86 - .90	.86 - .90	.95 - .96
Toluene, tanks, works. gal.	.45 - .45	.45 - .45	.35 - .35
Xylene, com., tanks. gal.	.30 - .40	.30 - .35	.36 - .40

## Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl. ton	\$23.00-\$25.00	\$23.00-\$25.00	\$23.00-\$25.00
Casein, tech., bbl. lb.	.154 - .16	.154 - .16	.154 - .16
China clay, dom., f.o.b. mine ton	10.00 - 20.00	10.00 - 20.00	10.00 - 20.00
Dry colors:			
Carbon gas, black (wks.) lb.	.08 - .13	.08 - .13	.064 - .07
Prussian blue, bbl. lb.	.35 - .36	.32 - .33	.31 - .32
Ultramarine blue, bbl. lb.	.06 - .32	.08 - .35	.08 - .35
Chrome green, bbl. lb.	.30 - .32	.30 - .32	.27 - .30
Carmine red, tins. lb.	6.00 - 6.50	6.00 - 6.50	5.25 - 5.50
Para toner. lb.	.70 - .75	.70 - .75	.70 - .80
Vermilion, English, bbl. lb.	1.85 - 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl. lb.	.17 - .174	.16 - .164	.154 - .16
Feldspar, No. 1 (f.o.b. N. Y.) ton	6.50 - 7.50	5.75 - 7.00	5.75 - 7.00
Graphite, Ceylon, lump, bbl. lb.	.074 - .084	.08 - .084	.08 - .09
Gum copal, Congo, bags. lb.	.074 - .08	.074 - .08	.074 - .08
Manila, bags. lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, onces. lb.	.24 - .25	.24 - .25	.22 - .23
Kauri, No. 1 cases. lb.	.48 - .53	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.) ton	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc. ton	40.00 - .07	40.00 - .07	40.00 - .07
Pumice stone, lump, bbl. lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casaka. lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H. bbl. lb.	8.65 - .54	8.45 - .54	9.85 - .54
Turpentine. gal.	.53 - .61	.54 - .61	.54 - .61
Shellac, orange, fine, bags. lb.	.58 - .59	.56 - .58	.54 - .56
Bleached, bonedry, bags. lb.	.43 - .44	.42 - .43	.44 - .45
T. N. bags. ton	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Sopstone (f.o.b. Vt.), bags. ton	9.50 - 10.00	9.50 - 10.00	10.50 - 11.00
300 mesh (f.o.b. Ga.) ton	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.) ton	13.75 - .1	13.75 - .1	13.75 - .1

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl. lb.	\$0.28 - \$0.32	\$0.28 - \$0.31	\$0.30 - \$0.32
Beeswax, ref., light. lb.	.41 - .42	.41 - .42	.41 - .42
Candelilla, bags. lb.	.23 - .24	.23 - .24	.23 - .24
Carnauba, No. 1, bags. lb.	.36 - .38	.36 - .38	.50 - .51
Paraffine, crude 105-110 m.p. lb.	.044 - .05	.044 - .05	.044 - .05

## Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18% ton	\$200.00 - .	\$200.00 - .	\$200.00 - .
Ferromanganese, 78-82% ton	105.00 - .	105.00 - .	105.00 - .
Spiegelisen, 19-21% ton	33.00 - .	33.00 - .	32.00 - .
Ferrosilicon, 14-17% ton	45.00 - .	45.00 - .	45.00 - .
Ferrotungsten, 70-80% lb.	1.35 - .	1.25 - .	.95 - .98
Ferro-uranium, 35-50% lb.	4.50 - .	4.50 - .	4.50 - .
Ferrovanadium, 30-40% lb.	3.15 - 3.75	3.15 - 3.75	3.15 - 3.75

## Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic. lb.	\$0.174 - .	\$0.18 - .	\$0.144 - .
Aluminum, 96-99% lb.	.24 - .26	.24 - .26	.24 - .25
Antimony, Chin. and Jap. lb.	.084 - .	.084 - .	.094 - .
Nickel, 99% lb.	.35 - .	.35 - .	.35 - .
Monel metal, blocks lb.	.28 - .	.28 - .	.28 - .
Tin, 5-ton lots, Straits. lb.	.454 - .	.434 - .	.464 - .
Lead, New York, spot. lb.	6.75 - .	7.00 - .	6.20 - .
Zinc, New York, spot. lb.	7.00 - .	7.00 - .	6.55 - .
Silver, commercial. oz.	.524 - .	.524 - .	.574 - .
Cadmium, lb.	.85 - .95	.85 - .95	.60 - .
Bismuth, ton lots. lb.	1.70 - .	1.70 - .	1.85 - .
Cobalt. lb.	2.10 - 2.50	2.10 - 2.50	2.50 - .
Magnesium, ingots, 99% lb.	.85 - 1.10	.85 - 1.10	.98 - .
Platinum, ref. oz.	65.00 - 66.00	66.00 - 68.00	75.50 - 76.50
Palladium, ref. oz.	38.00 - 40.00	38.00 - 40.00	46.00 - 49.00
Mercury, flask. 75 lb.	122.00 - .	123.00 - .	121.50 - .
Tungsten powder. lb.	1.35 - 1.50	1.35 - 1.50	1.05 - .

## Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks. ton	\$7.50 - \$8.00	\$7.50 - \$8.50	\$5.50 - \$8.75
Chrome ore, c.f. post. ton	22.00 - 25.00	22.00 - 24.00	22.00 - 23.00
Coke, idry, f.o.b. ovens. ton	2.85 - 3.00	2.85 - 3.00	2.85 - 3.00
Fluorspar, gravel, f.o.b. Ill. ton	18.00 - 20.00	18.00 - 20.00	16.00 - .
Ilmenite, 52% TiO <sub>2</sub> , Va. lb.	.004 - .004	.004 - .004	.004 - .
Manganese ore, 50% Mn., c.f. Atlantic Ports. unit	.34 - .37	.34 - .37	.36 - .38
Urbidene, 85% MoS <sub>2</sub> per lb. MoS <sub>2</sub> , N. Y. lb.	.48 - .50	.48 - .50	.48 - .50
Monasite, 6% of ThO <sub>2</sub> ton	80.00 - .	80.00 - .	130.00 - .
Pyrites, Span. fines, c.f. unit	.13 - .	.13 - .	.13 - .
Rutile, 94-96% TiO <sub>2</sub> lb.	.11 - .13	.11 - .13	.11 - .13
Tungsten, scheelite, 60% WO <sub>3</sub> and over. unit	15.00 - .	15.00 - .	10.50 - 10.75
Vanadium ore, per lb. V <sub>2</sub> O <sub>5</sub> lb.	.28 - .	.28 - .	nom. - nom.
Zircon, 99% lb.	.03 - .	.03 - .	.03 - .

# CURRENT INDUSTRIAL DEVELOPMENTS

## New Construction and Machinery Requirements

**Abrasive Plant**—Lionite Abrasive Ltd., Niagara Falls, Ont., branch of General Abrasive Co., H. A. Richmond, Genl. Mgr., Niagara Falls, N. Y., plans the construction of a 1 story, 85 x 360 ft. factory, including eight electric furnaces, etc., on Stanley St. Estimated cost \$150,000. Private plans.

**Alemite Products Plant**—Alemite Products Co. of Canada, Belleville, Ont., awarded contract for the construction of a new factory to W. H. Patterson Construction Co., Patterson Bldg., Belleville. Estimated cost \$60,000.

**Aluminum Factory**—United States Aluminum Co., Centre St., Garwood, N. J., awarded contract for a 1 story, 60 x 120 ft. addition to factory to Wigton-Abbott Corp., 705 Park Ave., Plainfield. Estimated cost \$40,000.

**Aluminum Casting Factory**—Quality Aluminum Casting Co., Waukesha, Wis., awarded contract for the construction of a 1 and 2 story, 88 x 105 ft. addition to factory, to C. A. Bailey & Son, 732 North Grand Ave., Waukesha.

**Aniline Products Plant**—Aniline Products Co., 45 East 17th St., New York, N. Y., is having plans prepared for a 3 story addition to plant at Lock Haven, Pa. Estimated cost \$200,000. Private plans.

**Bakelite Factory**—Bakelite Corp. of Canada, 163 Dufferin St., Toronto, Ont., plans the construction of a factory at St. Catharines. Estimated cost \$150,000. Engineers not selected.

**Bag Loading and Powder Factory Area Buildings, Etc.**—Constructing Quartermaster, Washington, D. C., awarded contract for the construction of bag loading area buildings at Picatinny Arsenal, N. J., to Nauman & Birtwell, Asbury Park, N. J., \$92,625. powder factory area building at Picatinny Arsenal to Van Asdlen Construction Co., Insurance Co. North American Bldg., Philadelphia, Pa., \$100,726; also received lowest bidder for powder magazine buildings at Aberdeen, Md., from R. G. Hopkins, 904 East 41st St., Baltimore, Md. \$49,927.

**Brass Factory**—C. H. Hanson Co., 178 North Clark St., Chicago, Ill., awarded contract for addition to factory for the manufacture of brass baggage checks, name plates, etc., to Seipp & Loneragan, 203 Wabash Ave., Chicago. Estimated cost \$50,000.

**Brass Rolling Mill**—Bridgeport Brass Co., C. E. Beardsley, Pres., East Main St., Bridgeport, Conn., plans the construction of a brass rolling mill. Estimated cost \$1,000,000.

**Brick Manufacturing Plant**—Bay State Abrasive Products Co., Westboro, Mass., is having plans prepared for the construction of a brick manufacturing plant. Estimated cost to exceed \$50,000. Private plans.

**Carbide and Carbon Factory**—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., plans the construction of a plant at Toledo, O. Estimated cost \$150,000. Private plans.

**Carbon Black Plant Units**—Eastern Carbon Black Co., Kanawha National Bank Bldg., Charleston, W. Va., has work under way on the construction of two units to carbon black plant, for Rock Creek plant, Borger, Tex. Private plans.

**Carbonate Factory**—Canadian Carbonate Co., Montreal, Que., plans the construction of a factory on Chabot St. Estimated cost \$30,000.

**Cellulose Acetate Plant**—Tennessee Eastman Corp., subsidiary of Eastman Kodak Co., 343 State St., Rochester, N. Y., awarded contract for the construction of first two units of plant for the manufacture of cellulose acetate for safety X-ray and other films to include power house, etc., at Kingsport, Tenn., to Gauger-Korsmo Construction Co., Fidelity Bank Bldg., Memphis, Tenn. Estimated cost \$1,000,000.

**Cement Plant**—Marquette Cement Mfg. Co., Louderman Bldg., St. Louis, Mo., awarded contract for the construction of a warehouse and storage silos to Gamble Construction Co., 620 Chestnut St., St. Louis. Estimated cost \$55,000.

**Cement Plant**—Paramount Portland Cement Co., 2030 Wilshire Blvd., Los Angeles, Calif., awarded contract for the construction of a cement plant to include packing house, machine shop, etc. at Torrance, to H. H. Helbush & Co., 2030 Wilshire Blvd., Los Angeles.

**Cement Plant**—Port Stockton Cement Co., San Francisco, Calif., is receiving bids for the construction of a cement plant at Stockton.

Estimated cost \$3,000,000. Roberts, Stevenson & Everett, 1101 Claus Spreckles Bldg., San Francisco, are architects.

**Chemical Factory Addition**—Dewey & Almy Chemical Co., 235 Harvey St., Cambridge, Mass., will build a 1 story, 80 x 180 ft. addition to chemical factory. H. L. Kennedy, 80 Boylston St., Boston, is architect. Work will be done by separate contracts.

**Compressed Gas Plant**—Presto-O-Lite Co., 30 East 42nd St., New York, N. Y., awarded contract for the construction of a new compressed gas plant at Oklahoma City, Okla., to C. B. Huffman, Oklahoma City. Estimated cost \$125,000.

**Coke Ovens**—Bethlehem Steel Co., Bethlehem, Pa., awarded contract for the construction of seventy-seven coke ovens, also coke handling equipment at Johnstown, Pa. to The Koppers Co., Frick Annex, Pittsburgh.

**Coke Plant**—Providence Gas Co., 100 Weybosset St., Providence, R. I., awarded contract for the construction of a coke plant of 25 ovens on Allens Ave. to Koppers Co., Union Trust Bldg., Pittsburgh. Estimated cost \$500,000.

**Cold Settling Plant**—Gulf Refining Co., Frick Annex, Pittsburgh, Pa., awarded contract for a cold settling plant on Girard Point, to John W. Gill Construction Co., City Central Bldg., Philadelphia. Estimated cost \$60,000.

**Copper Plant Addition**—Nichols Copper Co., Halle and Hobson Aves., Laurel Hill (mail Flushing) N. Y., plans a 3 story, 77 x 77 ft. addition to plant. Estimated cost \$40,000. Ledy & Moore, 70 West 40th St., New York, N. Y., are architects.

**Cotton Oil Mills**—Farmers Gin Co., Sayre, Okla., is having preliminary plans prepared for the construction of three cotton oil mills, one at Sayre, one at Jet and third at Gottebo. Estimated cost \$40,000, \$25,000 and \$25,000 respectively. Private plans.

**Fertilizer Plant**—F. S. Royster Guano Co., Norfolk, Va., awarded contract for the construction of a 175 x 400 and 60 x 100 ft. fertilizer plant to D. J. Rose & Son, Rocky Mount, N. C. Estimated cost \$250,000.

**Fibre Plant**—Keyes Fibre Co., Inc., W. E. Parsons, Waterville, Me., plans the construction of a fibre plant at Hull, Que. Estimated cost \$300,000.

**Fibre Plant**—National Automotive Fibres Inc., 2106 East Lafayette Ave., Detroit, Mich., is having plans prepared for the construction of a 1 story, 160 x 425 ft. factory at State Fair Ave. I. M. Lewis, 503 Congress Bldg., Detroit, is architect.

**Film Manufacturing Plant**—Universal Film Mfg. Co., Main St., Fort Lee, N. J., is receiving bids for a 2 story addition to plant on Main St. Estimated cost \$40,000. M. Freehop, 415 Lexington Ave., New York, is architect.

**Foundry**—Hull Iron & Steel Foundries Ltd., Montcalm St., Hull, Que., is having plans prepared for a 4 story, 90 x 300 ft. addition to foundry. Estimated cost \$200,000. New heat-treating steel ovens to produce high grade alloy steel will be required.

**Gas Plant**—Dominion Natural Gas Co., 516 Concession St., Hamilton, Ont., plans the construction of a new plant at London. Estimated cost \$2,000,000.

**Gasoline Plant**—Coline Oil Co., Trader National Bank Bldg., Oklahoma City, Okla., will build a two unit casinghead gasoline plant at oil field, south of Oklahoma City. Estimated cost \$50,000. Private plans.

**Gas Manufacturing Plant**—Philadelphia Electric Co., 9th and Sansome Sts., Philadelphia, Pa., awarded contract for the construction of a gas manufacturing plant at Chester to United Engineers & Constructors Inc., 112 North Broad St., Philadelphia.

**Gasoline Plant**—Sinclair Oil & Gas Co., Sinclair Bldg., Tulsa, Okla., is having plans prepared for the construction of a 16 unit natural gasoline plant near Sasakwa, Okla. Estimated cost \$75,000. Private plans.

**Gasoline Plant**—Skelly Oil Co., Skelly Bldg., Tulsa, Okla., had plans prepared for the construction of a natural gasoline plant at Asher. Estimated cost \$75,000. Private plans.

**Glass Plants**—Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Pa., awarded contract for two 1 and 2 story factory buildings at 53-75 Riverside Ave., Newark, N. J., to Public Service Production Co., 80 Park Ave., Newark, also 2 story, 50 x 120 ft. plant on Mill St., New Haven, Conn., to W. E. Greene Construction Co., 255 Church St., New Haven; plant to include cutting sheds, warehouse, tank sheds, etc. at Henryetta, Okla. Estimated cost \$200,000, \$40,000 and \$2,000,000 respectively.

**Hydrogen Plant, etc.**—Cudahy Packing Co., 803 Macy St., Los Angeles, Calif., awarded contract for the construction of a packing plant, including 40 x 61 ft. hydrogen plant, 47 x 49 ft. hydrogenating building, lard refinery, etc., to Pozzo Construction Co., 421 Macy St., Los Angeles. Estimated cost \$70,000.

**Ink Factory**—California Ink Co., 425 Battery St., San Francisco, Calif., awarded contract for an 8 story factory at Sansome and Merchant Sts. to Barrett & Hilt, 918 Harrison St., San Francisco. Estimated cost \$400,000.

**Ink Factory**—International Inks Inc., c/o P. Ruxton, Inc., 2211 Elston Ave., Chicago, Ill., awarded contract for the construction of a 4 story, 102 x 200 ft. printing ink factory to Poirot Construction Co., 38 South Dearborn St., Chicago. Estimated cost \$250,000.

**Iron Treating Plant**—United States Phosphoric Products Co., J. E. McKee, Gen. Mgr., Ruskin Rd., East Tampa, Fla., will build a 1 story, 130 x 160 ft. galvanized iron treating plant at Tampa. Estimated cost \$300,000. Private plans.

**Laboratory**—Commercial Agricultural College, F. L. Salmon, Storrs, Conn., will soon award contract for the construction of a 3 story, 60 x 110 and 60 x 225 ft. class room and laboratory at Storrs. Estimated cost \$300,000. D. K. Perry and E. E. Bishop, 17 Court St., New Britain, Conn., are architects.

**Laboratory**—Montefiore Hospital, S. G. Rosenblum, Pres., 730 5th Ave., New York, N. Y., plans addition to hospital including new laboratory, etc. Estimated cost \$1,000,000. Kohn & Butler, 56 West 45th St., New York, are architects.

**Laboratory (Chemical)**—Brooklyn Union Gas Co., 176 Remsen St., Brooklyn, N. Y., plans addition to chemical laboratory on 12th St. Estimated cost \$25,000. H. P. Kirkham, 176 Remsen St., Brooklyn, is architect.

**Laboratory (Chemistry)**—Bd. of Education, Chillicothe, O., is having plans prepared for the construction of a 3 story, 150 x 187 ft. high school including chemistry laboratory. Estimated cost \$300,000. Garber & Woodward, 4 West Seventh St., Cincinnati, are architects.

**Laboratory (Chemistry)**—Colgate University, McGregory Hall, Hamilton, N. Y., awarded contract for the construction of a chemistry laboratory to Waldo Griffiths Co., Mayo Bldg., Utica, N. Y. Estimated cost \$368,000.

**Laboratory (Chemistry)**—Washington & Jefferson College, Washington, Pa., will receive bids about Aug. 1 for the construction of a 2 story chemistry laboratory. Estimated cost \$250,000. Hopkins & Deutz, 415 Lexington Ave., New York, N. Y., are architects.

**Laboratory (Pharmacy and Bacteriology)**—Bd. of Trustees, Ohio State University, C. L. Steeb, Secy., Columbus, O., will receive bids until July 31 for a 4 story, 60 x 200 ft. laboratory on Campus. Estimated cost \$250,000. J. N. Bradford, Ohio State University, Columbus, is architect. Equipment will be purchased later.

**Laboratories (Science)**—Pasadena College, Pasadena, Calif., is having preliminary sketches made for the construction of a college including science laboratories, etc. Estimated cost \$500,000. Marsh, Smith & Powell, 514 Architects Bldg., Los Angeles, W. P. Shepherd, 15 South El Molino St., Pasadena and Lansdowne Construction Co., Santa Ana, are architects.

**Laboratories (Science)**—Schoolhouse Dept., Boston, Mass., will soon award contract for the construction of new science laboratories for Dorchester and Charlestown high schools. Private plans. Equipment will be required.

**Lamp and Radio Novelty Factory**—Youngstown Radio, Lamp & Novelty Co., D. Orsi, Youngstown, O., plans the construction of a 1 story factory for the manufacture of lamps and radio novelties. Estimated cost \$40,000. Electrical equipment will be required.

**Leather Factory**—Hubschneider & Sons, Orianna and Willows Sts., Philadelphia, Pa., will soon award contract for addition to factory. Estimated cost \$40,000. Ballinger Co., 12th and Chestnut Sts., Philadelphia, is architect.

**Leather Goods Factory**—R. H. Buhrke Co., 4540 Fullerton Ave., Chicago, Ill., awarded contract for masonry, etc. for a 2 story, 100 x 125 ft. factory at 4538 Fullerton Ave. Estimated cost \$60,000.

**Magnesia and Asbestos Products Factory**—Norristown Magnesia & Asbestos Co., Ford and Washington Sts., Norristown, Pa., awarded contract for the construction of a 1 story, 96 x 360 ft. factory and warehouse, etc., at Ford and Washington Sts., to J. R. Heavner, Norristown. Estimated cost \$50,000.

**Match Factory**—Hull Match Co., St. Redempeur St., Hull, Que., plans the construction of a match factory. Estimated cost \$125,000. Machinery and equipment will be required.

**Metakloth Factory**—Metakloth Co., Inc., Garibaldi Ave., Lodi, N. J., will soon award contract for a 1 story addition to factory. Estimated cost \$40,000. Liebau & Breiby, 238 Main St., Hackensack, are architects.

**Metal and Aluminum Powder Plants**—Reynolds Metals Co., 30th and Grand Ave., Louisville, Ky., is having plans prepared for the construction of a 2 story, 90 x 100 ft. factory for the manufacture of tin, lead, and aluminum foil on Hale Ave. \$60,000. O. P. Ward, Lincoln Bldg., Louisville, is architect. Also plans first unit of factory for the manufacture of aluminum powder at Camp Ground Rd. A. G. Tafel, 140 South Third St., Louisville, Archt.

**Nitrate Plant**—Lautaro Nitrate Co. Ltd., Valparaiso, Chile, awarded contract for the design and construction of a nitrate plant using Guggenheim process for nitrate recovery and concentration, to Guggenheim Bros., 120 Broadway, New York, N. Y. \$32,000,000 financing. Maturity in fall.

**Paint Factory**—Golden Standard Paint Co. Ltd., St. Boniface, Man., plans the construction of a paint factory. Estimated cost \$150,000.

**Paint and Chemical Factory**—Hampden Paint & Chemical Co., 161 Armory St., Springfield, Mass., awarded contract for rebuilding plant at Albany and Armory Sts., destroyed by fire to E. F. Carlton Inc., 1694 Main St., Springfield. Estimated cost \$40,000.

**Paper Factory**—Pacific Coast Pulp & Paper Co., Los Angeles, Calif., awarded contract for the construction of a group of buildings for paper factory at Richvale, to C. S. Mabry Co., 4th and J Sts., Sacramento. Estimated cost \$400,000.

**Paper Plant**—Chemical Paper Co., R. Bosworth, Holyoke, Mass., will soon award contract for a 2 story, 60 x 215 and 60 x 107 ft. paper plant on Jackson St. Estimated cost \$175,000. Private plans.

**Paper Products Plant**—Superior Paper Products Co., Carnegie, Pa., is having plans prepared for the construction of a 1 story, 180 x 360 ft. plant. Estimated cost \$150,000. Braziell & Anderson, 309 4th Ave., Pittsburgh, are architects.

**Pottery Plant**—Potters Supply Co., East Liverpool, O., awarded contract for a 2 story, 40 x 210 ft. factory on Washington St., to J. A. Bryan Co., East Liverpool, O. Estimated cost \$75,000. Clay machinery will be required.

**Powder Plant**—Hercules Powder Co., Parlin, N. J., awarded contract for a 2 story powder plant at Sayreville, to Rogers & Sons Construction Co., 71 John St., New Brunswick. Estimated cost \$40,000.

**Pulp and Paper Mill**—Pacific Coast Pulp & Paper Corp., Richvale, Calif., awarded contract for the construction of a pulp and paper mill including, boiler room, machine shop, beater room, etc. to C. S. Mabry Co. Inc., 4th and J Sts., Sacramento. Estimated cost \$397,878.

**Refinery, Oxygen Plants, Etc.**—Globe-Pico Mfg. Co., c/o W. E. Keller, El Paso, Tex., has consolidated with Anderson-Clayton Co., Cotton Exchange Bldg., Houston and plans the construction of new oil mills, refinery and oxygen plants, also extensions and improvements to cotton gin plants in lower Rio Grande valley recently acquired. Machinery and equipment for all plants will be required.

**Refinery (Gasoline)**—Phillips Petroleum Co., Bartlesville, Okla., is having preliminary plans prepared for the construction of a gasoline refinery, 5,000 bbl. capacity to include steel tanks, etc., at Wichita, Kan. Estimated cost \$250,000.

**Refinery (Oil)**—Mid Texas Oil & Gas Co., Mid-Texas Refining Co. and Mid-Texas Pipe Line Co., Abilene, Tex., plan the construction of an oil refinery including booster plant, repressing plant for old wells, etc. Machinery and equipment to cost \$38,000 will be required.

**Refinery (Oil)**—Phillips Petroleum Co., Bartlesville, Okla., is having plans prepared for the construction of a 5,000 bbl. refinery at Wichita, Kan. Estimated cost \$150,000. A. H. Riney, 1434 Dewey St., Bartlesville, Okla., is architect.

**Rubber Factory**—Mohawk Rubber Co., S. S. Miller, Pres. and Gen. Mgr., Akron, O., is receiving bids for a 3 story, 75 x 100 ft. factory. Estimated cost \$125,000. Henry & Murphy, Second National Bldg., Akron, are architects.

**Rubber Factory**—Thermoid Rubber Co., Whitehead Rd., Trenton, N. J., awarded contract for a 100 x 170 ft. addition to rubber factory to W. C. Ehret, Trenton Trust Bldg., Trenton. Estimated cost \$100,000.

**Silk and Rayon Factory**—J. P. Tate, et al., High Point, N. C., plan the construction of a factory, 10,000 to 20,000 towels daily capacity, also manufacturers of linen, cotton, silk and rayon fabrics. Estimated cost \$1,000,000.

**Starch Works**—Piel Bros. Starch Co., 1515 South Dover St., Indianapolis, Ind., awarded contract for a 40 x 91 ft. factory at 1515 Dover St. to Brown & Mick, 226 East Michigan Ave., Indianapolis. Estimated cost \$43,150.

**Sulphuric Acid Plant**—Stauffer Chemical Co., Hammond, Ind., awarded steel contract for the construction of first unit of chemical factory. Estimated cost \$1,000,000.

**Tile Plant**—Owner, c/o P. Hemphill, c/o Portland Cement Assn., Athletic Bldg., Dallas, Tex., plans the construction of a tile plant at Corpus Christi. Estimated cost \$275,000. Machinery and equipment to cost \$200,000 will be required.

**Tile Plant**—C. Pardee Works, Smith St., Perth Amboy, N. J., will soon award contract for a 1 story, 60 x 115 ft. addition to tile plant on Herbert St. Estimated cost \$40,000. Larson & Fox, 175 Smith St., Perth Amboy, N. J., are architects and engineers.